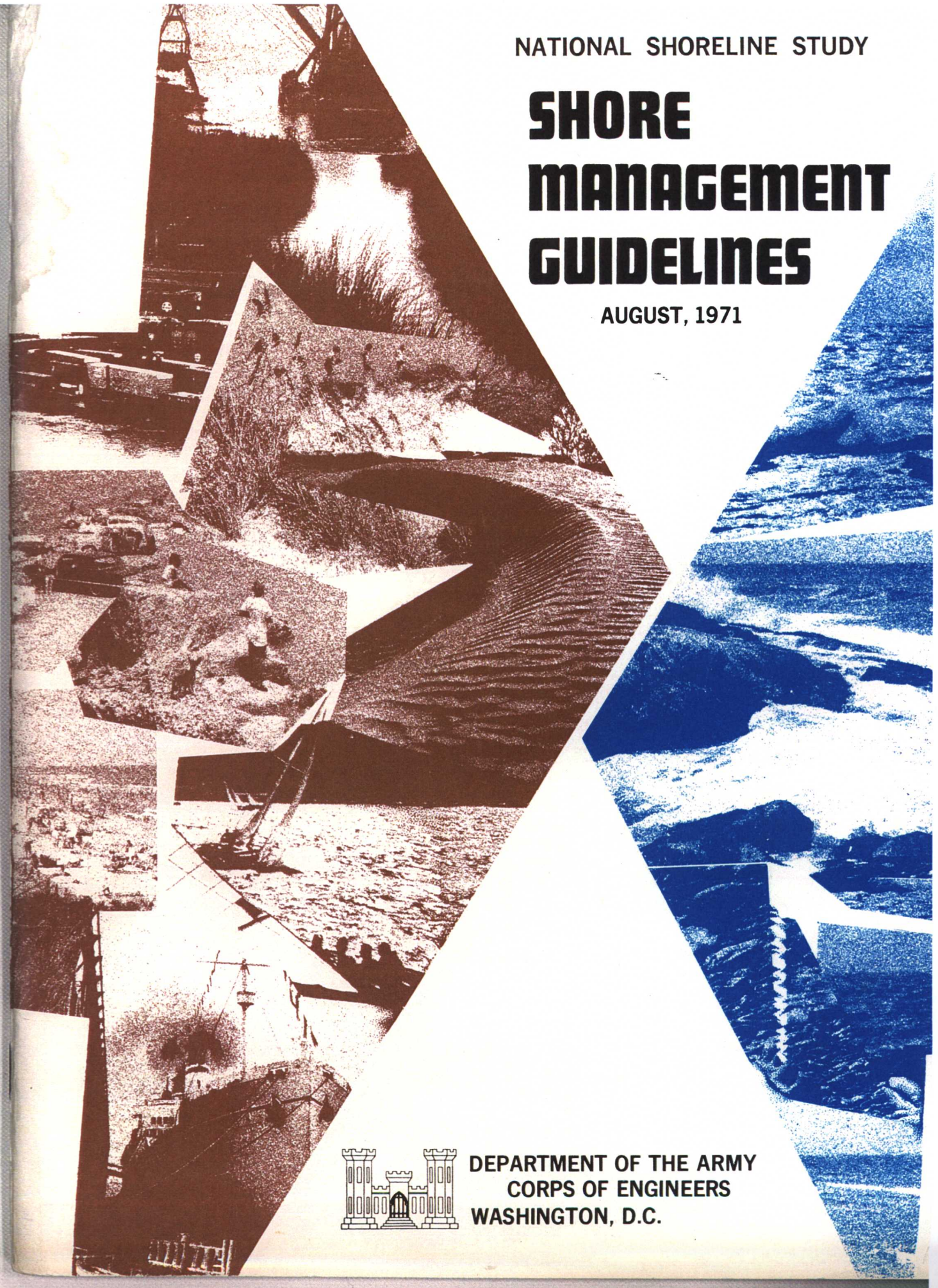
NATIONAL SHORELINE STUDY

SHORE MANAGEMENT GUIDELINES

AUGUST, 1971



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
WASHINGTON, D.C.

The National Shoreline Study

How will the shore be used ?

SHORE MANAGEMENT GUIDELINES

What is its condition ?

REGIONAL INVENTORY REPORTS

What can be done ?

to preserve or enhance the shore,
by using—

- Engineering techniques

  SHORE PROTECTION GUIDELINES

  REGIONAL INVENTORY REPORTS

- Management techniques

  SHORE MANAGEMENT GUIDELINES

Shore Management Guidelines

The purpose of this guide is to assist **decision makers**:

- **In evaluating the need and feasibility of preserving and enhancing their shores, and**
- **In developing and implementing a plan for doing so.**

In 1968, the 90th Congress authorized this National appraisal of shore erosion and shore protection needs. This National Shoreline Study and the existing Federal shore protection programs recognize beach and shore erosion as problems for all levels of government and all citizens. To satisfy the purposes of the authorizing legislation, a family of 12 related reports has been published. All are available to concerned individuals and organizations in and out of government.

REGIONAL INVENTORY REPORTS (one for each of the 9 major drainage areas) assess the nature and extent of erosion; develop conceptual plans for needed shore protection; develop general order-of-magnitude estimates of cost for the selected shore protection; and identify shore owners.

SHORE PROTECTION GUIDELINES describe typical erosion control measures and present examples of shore protection facilities, and present criteria for planning shore protection programs.

*SHORE MANAGEMENT GUIDELINES** provide information to assist decision makers to develop and implement shore management programs.

REPORT ON THE NATIONAL SHORELINE STUDY addressed to the Congress, summarizes the findings of the study and recommends priorities among serious problem areas for action to stop erosion.

**Shore Management Guidelines* was prepared by the Center For The Environment and Man, Inc., Hartford, Connecticut under contract DACW 73-71-C-0037. June 1971

CONTENTS

Since the earliest times, the interface of land and sea has increasingly nurtured and shaped a developing civilization. Now technologically light years away from the primitive beginning, the need—emotionally and economically—for the coastal environment is as great or greater than ever.

The coastal environment is dynamic—it continues to change in both its natural and social contexts. The shore continually erodes and accretes; major parts of it are currently receding. And there are more people there now, doing more things. Life along the shore, both human and non-human, continues to be shaped by these continually changing natural and social forces—some of which are man-controllable.

Increasing population concentrations in the coastal region forecast for the future are sobering reminders that the environmental stresses already perceived will worsen; conflicts and challenges will intensify. The planner will be forced to make more difficult choices among complex alternatives and to mediate a bewildering array of conflicting claims for residential, commercial, industrial, and recreational land uses, commercial fishing privileges, transportation, ecological and wildlife protection, resource extraction, waste disposal, and more. Human uses must be decided in the context of an environment that it is always changing, never the same, yet never different—waves, currents, wind, storms, building up, tearing down, continually reshaping.

These *Guidelines* consider the shore as a part of the larger coastal zone, an area in which the land is intimately affected by the sea and the sea is intimately affected by the land. Physically, the shore is represented only by a narrow strip of sea/land close to the high and low water marks. The shore in this text is also defined by all of the uses that are made of it by man and nature. These uses and the physical conditions together make up a complex web of asso-

ciation which is the shore. The intent here is not to define the shore rigorously but rather to suggest the spirit in which it must be considered.

The shore is complex, changing, and of critical importance. Management can help assure that it is used and developed in a way that respects its natural and social significance for current and future generations.

Shore management is defined here as a process of (1) evaluating needs for preserving and enhancing the shore, (2) examining techniques to satisfy the needs, (3) formulating a plan, and (4) implementing the plan. Preservation is seen as maintaining the shore essentially in its current condition. Enhancement is seen as modifying the shore in a way that society judges to be desirable. Both preservation and enhancement may serve society, or ecological balance, or both in a symbiotic relationship.

The "planner" who initiates the process can be a solitary individual responsible for a small project or a comprehensive interdisciplinary team concerned with developing large-scale plans. Regardless of the scope of the plan or size of the planning team the process will be basically the same.

In general, the process can be stated in the following key, interrelated questions:

Who is to do the necessary planning?

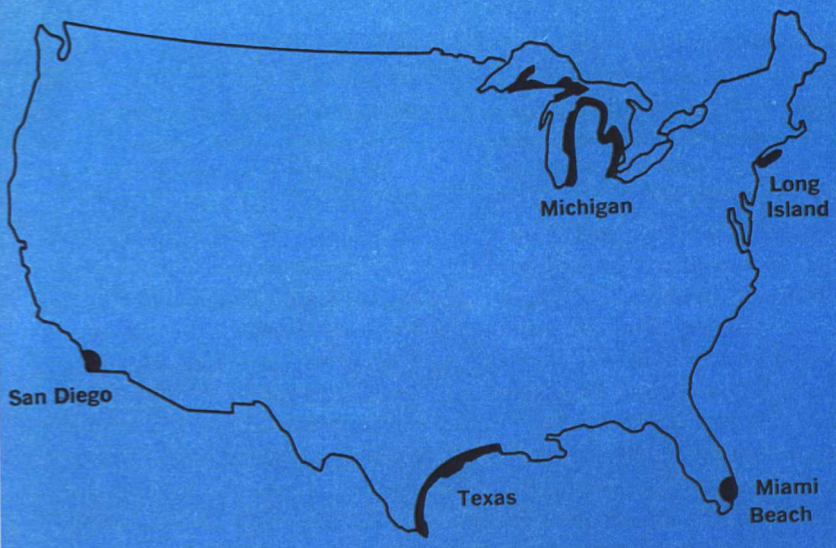
What kind of shore is needed?

What techniques are available for satisfying these needs?

How can these needs and techniques be formulated into a plan?

How can lessons learned in implementing the plan be applied?

Before developing a way of answering these questions, these *Guidelines* will now look at some actual examples of shore management problems.



Part 1 **Examples**

Shore management problems, solutions and programs vary widely in type, breadth and complexity. Five current shore management situations have been chosen to highlight the nature of some of the problems faced and the approaches taken. Later in Part 2, shore management will be examined in a broader way and a general planning procedure will be developed, drawing frequently upon these examples.

At the *municipal* level, San Diego illustrates the creation of recreational beach near the middle of a large city.

At the *metropolitan-county* level, Miami Beach illustrates the differences in public and private viewpoints in an intensely developed luxury area.

At the *multi-county* level, Long Island illustrates problems of satisfying mass urban needs for beach recreation.

At the *state level*, Michigan illustrates an approach to shore management emphasizing preservation.

At the *state level*, Texas illustrates an approach to comprehensive coastal zone management.

Mission Bay, San Diego

Spurred by some long-range city planning programs initiated at least as far back as 1930, San Diego has planned, provided and operated a large aquatic park near the heart of the city at Mission Bay. The development is a major example of shore enhancement aimed at the goal of satisfying a wide variety of close-in marine recreation desires of an urban population and of regional visitors.

Almost from the beginning, San Diego evaluated this goal against a backdrop of predicted rapid expansion in population, affluence, leisure, and outdoor appreciation. The city rejected the alternative of letting supply and demand find their own equilibrium. Under that approach demand would level off at a point at which the price (as measured in such things as increasingly difficult access and congestion problems) would equal the public's appraisal of the value of the diminished recreational experience. Instead

the city embarked on a program of encouraging its visitors to enjoy its shore by improving the quality of the public experience in every feasible way. Beach densities were to be kept low and as many restraints to enjoying the beach as possible were to be removed. This seemingly contradictory goal—improving both quantity and quality of an apparently limited resource simultaneously—was achieved by a combination of engineering and management techniques. Over several decades and overcoming a number of technical and financial problems, engineering techniques were employed to create 18 miles of new recreationally-desirable waterfront and to stabilize parts of the shore exposed to tidal currents.

The following inventory illustrates what a clear goal implemented by wise management can accomplish:

- *Public participation.* The people of San Diego have backed the park by approving all capital expenditures in the form of bond referendums that require a minimum of 66⅔% approval.
- *Acquisition.* With one exception, all the land was acquired in fee simple for public ownership. The exception was caused by a legal technicality that will be eliminated shortly.
- *Cost sharing.* The $52 million capital cost to date was shared about 20% national, 10% state, 30% city and 40% lessees. Annual rental from lessees who owned and operate facilities such as hotels, marinas, museums and restaurants provides enough to meet all city costs of operating the park.
- *Zoning.* The bay is zoned to minimize conflicts of usage and to accommodate multiple public recreational appetites.
- *Building codes.* All construction in the Bay is controlled to promote architectural compatibility as well as public safety.
- *Police powers.* The city exercises its police powers for the public good by establishing and enforcing speed limits, safety regulations and nuisance control measures on land and water.

Were the concept of Mission Bay introduced today, considerably more attention would probably be given to the park's ecological implications, and the trade-off between the preservation of wetlands and mass urban beach recreation. What kind of decision would result is conjecture—possibly the same result, possibly different. Through the years, the people of San Diego have repeatedly endorsed the park and other beach enhancement projects. They are patronizing Mission Bay, and all of the City's beaches, in greatly increasing numbers—from 2 million in 1962 to over 5 million in 1968 to a projected 7 million by 1980 and 12 million by 1990.

San Diego has been successful in assessing recreational needs and in satisfying them. The process may be applicable elsewhere.

Mission Bay in 1935, an area of tidal mudflats on the suburban periphery of San Diego. Note that the city had already begun to develop around it. The area provided valley storage for floodwaters that periodically inundated it.

The City has zoned the bay to accommodate a wide spectrum of recreational uses. The zoning changes from time to time along with public wants. A recent allocation is indicated below.

1 Public bathing areas—best for swimming
2 Public bathing areas—best for surf bathing
3 Camping grounds
4 Trailer area
5 Hotels, motels and resorts
6 Boating facilities, either public rental or privately owned
7 Public boat launching ramps
8 Speedboat area
9 Water skiing area, all hours
10 Water skiing area, off hours only
11 Museum—Sea World
12 Golf course
13 Model boat basin
14 Sports fish landing, bait barge, equipment
15 Shore fishing
16 Privately-owned waterfront, for public acquisition in near future
17 Amusement park
18 Channel to ocean
19 Undeveloped area, unallocated to allow for future options
20 Flood control channel, adjacent areas zoned for flood plain uses
21 Indoor heated pool, free swimming lessons

Public restrooms, lifeguards and parking facilities are found throughout the area. The roadnet provides rapid access from all parts of the city. Liquid waste disposal in the vicinity is by ocean outfall.

Mission Bay in 1969. About 18 miles of new, accessible shoreline have been created in a 7 square mile area. Floods have been channelized through the diked floodway on the right. Note greatly increased urbanization.

Miami Beach

The City of Miami Beach and adjacent communities to the north are located on two long, flat, rather narrow barrier islands off the coast of Florida. A ten-mile reach of this ocean-front has been transformed since World War I, largely by private interests, from a mangrove swamp into what is possibly the most densely concentrated luxury resort area in the world.

But the beach fronting this development is receding, causing diminution of beach recreation and increasing the exposure to erosion and hurricane damage. There is a clear, widely-recognized need for restorative action.

Stability of this beach depends upon its ability to receive and hold a continuing resupply of sand from the north (littoral drift) or from other sources. Natural inlets and beaches to the north—and man-made changes to them—are reducing the input. Storm waves impacting on vertical bulkheads accelerate the erosion. During major hurricanes, flooding has been several feet deep and sand has invaded streets and structures.

Proposals for restoration of the beach have come from private property owners and various levels of government. Though everyone agrees that something must be done, the proposed solutions represent a complex contest between concepts of private and public rights to a natural resource.

The foreshore is the part of the beach held in trust by the State for the public welfare and the backshore is the part of the beach held by individual property owners.

The boundary line between these two interests, and the respective rights enjoyed, has been the subject of much dispute. In an attempt to clarify jurisdiction, various lines—harbor lines, bulkhead lines, preservation lines, setback lines, erosion control lines and project lines—have been defined. They are all related in one way or another to the mean high water line. None has been entirely successful in clearly demarking ownership rights and numerous court actions have contested their legality and interpretation. A major reason for this contestability is the changeable nature of the coast. It is a generally accepted principle in Florida that the riparian owner's property expands with natural accretions and contracts with natural erosion. Man-influenced changes are another thing. Some feel that the hotel owners have substantially contributed to the erosion problem by building too close to the beach.

The various levels of government involved—federal, state, county and municipal—generally support a plan calling for the restoration with offshore sand of about 10 miles of beach, along which about one-third of the backshore is public and two-thirds privately owned. The result would be a 200-foot wide beach, 9 feet above the mean low water datum. This new beach would cover the existing groins and would have a 2½ foot high dune along its inland edge. The beach and dune together would act as attenuators of hurricane waves and a barrier against flooding by ocean-side wave runup and tides for all but the most infrequent hurricanes. Costs for the project are presently estimated at $35 million. Construction time would be about 6 years. The federal government would share 60% to 70% of total costs. In recommending authorization of the project, the Secretary of the Army gave as a precondition for Federal support that local interests furnish assurances that they will establish and continue public use of all of the new beach fill seaward of the landward limit of the project, together with acceptable access necessary for public use.

The oceanfront hotel owners do not support this plan. They feel that the receding shoreline is moving the public-private boundary inland, to their great disadvantage. They claim that this erosion is, at least in part, man-influenced, and that they have been denied adequate opportunity to protect their property against it. They view the imposition of a broad, man-created, easily-accessible, public beach between them and the ocean as impairing their riparian rights and a substantial economic loss to them of "many millions of dollars."

The oceanfront owners' proposal involves a combination of groin improvements, pumping sand across an inlet and some sand replenishment from offshore. They propose that hurricane protection features, includ-

"Receding beaches increase the likelihood of structural damage to hotels along Miami's beaches. The pictures show the most and least eroded beaches."

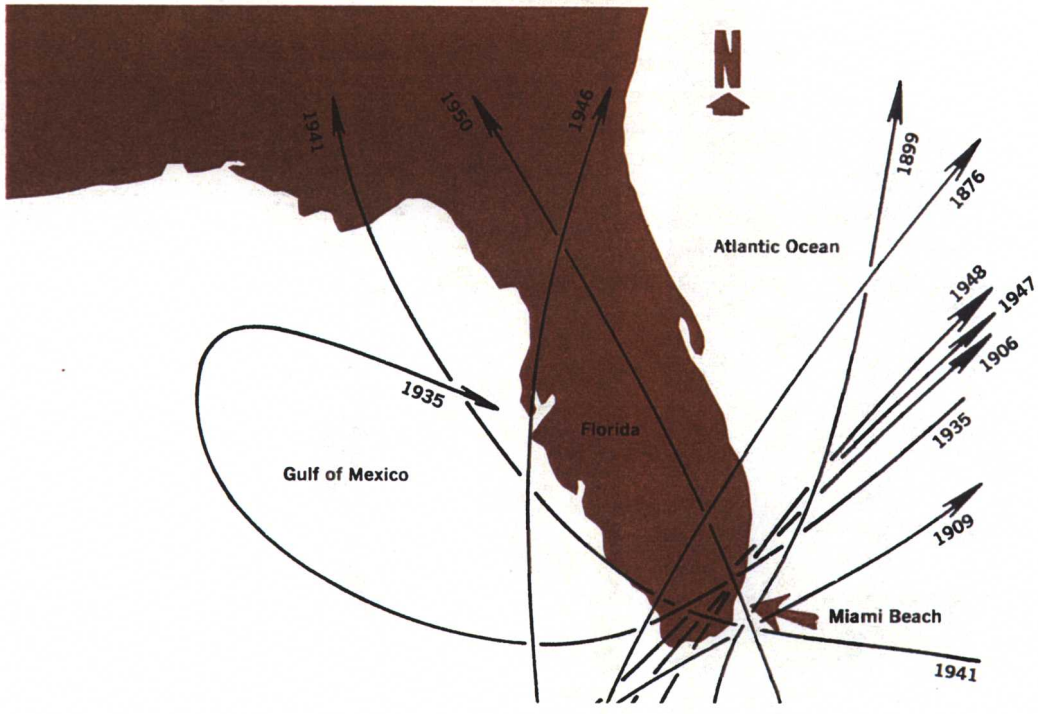
ing the objectionable dune, be considered separately after further study. They estimate costs would be about $4 million for a 7.6-mile long beach and that construction would take about two years. Most of the costs would be borne by the hotel owners. The proposed program envisions voluntary coordinated participation by all owners.

The oceanfront hotel owners consider their plan to be technically superior. They feel that it can be implemented much sooner, costs less and would protect what they consider to be their riparian rights under which they have invested at least a half a billion dollars in resort facilities. In appraising the government plan, they question the need for more public beaches, at least at their doorsteps; the likelihood of obtaining federal and state funds soon; and the financial capability of local government to fund the added costs of providing lifeguard, beach cleanup, periodic renourishment and other services over a new and wider beach, publically used throughout its length.

Those who support the government plan feel that it employs techniques and a scale consistent with the natural forces involved, costs less in the long-run, and provides for adequate public use and movement on the wide groinless beach. In appraising the oceanfront hotel owners plan, they question the feasibility of depending primarily upon groins and spot nourishment; the lack of hurricane protection; and the adequacy for public use of a relatively narrow beach segmented with groins that significantly impede movement up and down the beach. Some feel that if the unanimous, voluntary coordination envisioned by the hotel owners is not achieved, the hotel plan could become ensnarled in major legal difficulties.

Recently the city attempted to condemn a portion of one of the hotel's ocean frontage needed for the government project. The hotel contested the action, but a court found that the hotel's owners would benefit from the government project far more than they would lose. The city has hailed the decision as a landmark, opening the way to support the government plan, but the oceanfront hotel owners question its precedent value.

Notwithstanding their differences in viewpoint, all parties are united in their recognition of the growing urgency of restoring the beach. Perhaps a solution can be reached that will provide ample public access and use of the restored beach, but will regulate beach use in a way that will assure the hotel owners the reasonable privacy and appealing foreshore they need.



Paths of hurricanes passing within 50 miles of Miami Beach during October and November. Since 1830, 25 hurricanes have passed this close.

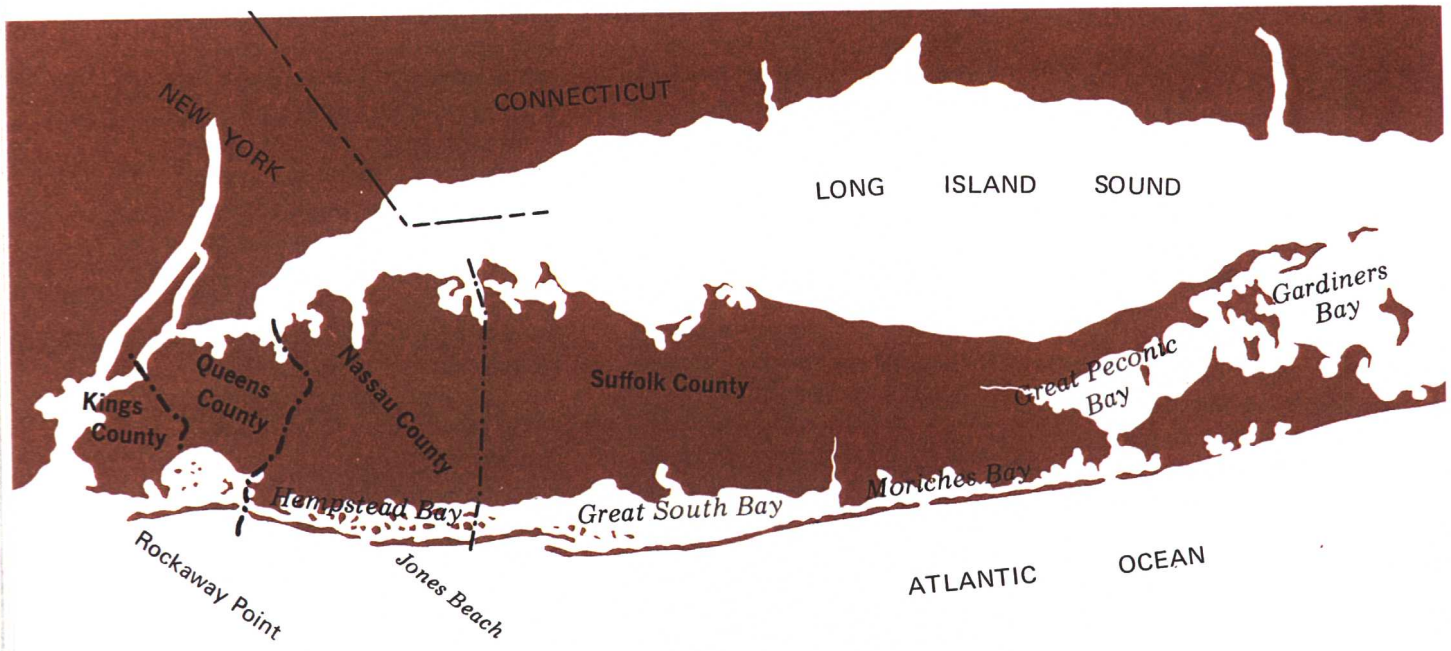
Long Island, New York

Long Island illustrates problems, at the multi-county level, of satisfying mass urban needs for beach recreation. Located near the western end of the island is one of the most densely populated areas in the world. People from all parts of New York City, and the surrounding metropolitan area, use the island's beaches. Two of the city's boroughs, Kings (Brooklyn) and Queens Counties, are located on the island. Together, they include only 14 percent of the island's 1,400 square mile land area but about two-thirds of its 7 million residents.

Annual attendance at all of Long Island's beaches probably exceeds 70 million. As large as this attendance is, there is considerable evidence that it would be much larger today and would grow considerably in the future, if some well-identified deterrents can be minimized, if some major socio-economic trends continue and if some broad social goals can be attained. For example,

- Swimming is, and is expected to remain, by far the most popular form of outdoor summer recreation in the vicinity. It accounts for as much participation as all other outdoor recreation activities combined. Swimming pools and travel to inland fresh water bodies can satisfy some of the demand, but the ocean beaches are expected to play the major role.
- A recent household survey revealed that less than half the residents of Nassau-Suffolk Counties use the beaches. After discounting the very young and very old, about half of the remaining non-users gave reasons such as overcrowding, inadequate beach maintenance and transportation difficulties.
- Although population is tending to stabilize in the city and its

ken Meadow State Park, Long Island, ' York. Beach density is about 20 square per person. This beach accommodates ut two million visitors annually.



ESTIMATED RECENT ANNUAL ATTENDANCE AT SOME MAJOR LONG ISLAND BEACHES

(Rounded to the nearest million)

Kings County	**20 million**	**Coney Island**
	2 million	**Manhattan Beach**
Queens County	**15 million**	**Rockaway Beach**
	2 million	**Jacobs Riis**
	1 million	**Jamaica Bay**
Nassau County	**13 million**	**Jones Beach**
Suffork County	**2 million**	**Robert Moses**
	2 million	**Sunken Meadow**

Coney Island and Coney Island Beach looking east.

nearer suburbs, population is growing rapidly in the outlying areas. In Suffolk County the permanent population was 197,000 in 1940, 667,000 in 1960 and is projected to be about two million in 1985. These data do not include the influx of summer residents. For example, vacation homes represent some 45% of eastern Suffolk's housing.

- Major long-range trends such as increasing affluence and more leisure time, much of which is spent out-of-doors, point toward a growing per capita demand. Some ethnic and economic groups that now account for a small percent of total users are expected to increase their participation rapidly to a level somewhere near the overall average.

- Changes in transportation can greatly influence beach attendance. For example, about 75% of the users of Nassau-Suffolk County beaches are currently either permanent or vacation residents. Less than 1% of users of these beaches come by bus. With the opening of the Long Island Expressway, Manhattan is now about two hours driving time from Riverhead when traffic is flowing freely. Changes in subway, bus or ferry services to the beaches in Kings and Queens Counties could have a major impact on beach demand there. If beaches are developed in Jamaica Bay, as some propose, they will be within a half-hour's *walking* distance of about two million people.

To quantify the current and predicted levels of demand under certain estimated socio-economic and environmental quality conditions in the future, statewide models have been developed to integrate a number of factors. These factors include such things as the number of automobiles per family, the family income, home ownership, family size, the number in the family less than 12 years old, the educational level of the head of the family, age, race, the number of vacation days in the past year, and population density. Other factors such as travel time and the length of the shoreline have also been included. These analyses are useful in expressing the demand-supply relationship. However, many who have studied the situation have reached a conclusion similar to that expressed by the U.S. Outdoor Recreation Resources Review Commission in 1962.

> The fantastic crowding of beaches close to New York City renders superfluous all surveys, studies and analyses that seek to prove that more close-in beaches are needed. It would be impossible to develop enough close-in beaches to meet the present demand, let alone create an oversupply for the future.

Statewide beach capacity standards have been developed in terms primarily relating to the length of shoreline—about one person bathing or sunning per lineal foot of public swimming beach shoreline. For a 100-foot deep beach, this is 100 square feet per person—the same standard used by San Diego. Total observed attendance at monitored beaches on summer Sundays exceeds these capability standards by factors ranging from three for Suffolk County beaches to 25 for Queens County beaches!

Broad strategies often proposed include:

- *Acquisition.* Most of the shore suitable for beach recreation in Kings and Queens Counties is already publically owned, and the cost of the remainder is very high except for several military facilities that have been phasing out of the area. In Nassau and Suffolk Counties, public acquisition has been a major tool. About 60,000 acres, some 7% of the bi-county land area, is currently held for all forms of public recreation. According to estimates of various bi-county and regional planning groups, there is a need to nearly double the existing total acreage in the next two decades. Acquisition costs recently have averaged about $18,000 an acre in Nassau and about $6,000 an acre in Suffolk.
- *Development.* About a third of this 60,000 acres has been acquired within the past 10 years and is in the planning and development stage. Of this undeveloped acreage, about 9,000 acres are being planned for conservation purposes, including wildlife refuges, wetland preservation areas, open space and buffer zones. The remaining 15,000 acres are being planned mainly for natural area recreation use. Transportation, parking and beach facilities are major factors in this planning. The accelerated development of the potential for swimming at Gilgo State Park near Jones Beach has been proposed, subject to protection of the natural environment. As part of its proposed Gateway National Recreation Area, the U.S. Department of the Interior has suggested the development of a facility to accommodate 27 million visitors annually at Breezy Point with access by ferry. The National Academy of Sciences and National Academy of Engineering (NAS-NAE) have jointly suggested the development of Jamaica Bay for

multi-use conservation, residential and recreational purposes. Although the NAS-NAE do not anticipate that bathing-quality water will be produced in the entire bay until nearly 1980, they feel that certain areas of the bay even now have waters of reasonably high quality. Under the NAS-NAE suggestion, selective dredging and filling would enhance the bay for recreational and residential uses in a way that would also preserve and possibly enhance the bay's biological life. If feasible, the concept could be extended in the long-range future to carefully selected parts of the extensive internal coastline between the barrier islands and the main island along the South Shore.

- *Shore protection.* Ways of protecting Long Island's shoreline from the forces of nature have been receiving intensive study. Hurricanes strike the island at about a ten-year frequency and littoral drift along the south shore is unusually strong; it increases in its generally westward flow from almost nothing at the eastern tip of the island to 600,000 cubic yards of sand annually passing Robert Moses State Park. The *Regional Inventory Report* for the North Atlantic Region reveals a pattern of long alternating periods of major shoreline recession and advancement over the past century and a half. Erosion can be a problem on almost all parts of the coast, but it is particularly severe along the exposed oceanfront of Nassau and Suffolk Counties, with a consequent reduction of beach areas for recreation and for protection against storm erosion and hurricane damage. Along the North Shore, and elsewhere, it might be economically feasible to enhance some recreational beaches by sand nourishment techniques that respect the biological values involved.
- *Broad planning.* All levels of government—federal, state, local—are active to varying degrees in studying and planning for the marine resources in the Long Island area. Planning is particularly active at the local level; for the eastern two counties, the Nassau-Suffolk Regional Planning Board and its Marine Resources Council have a strong coastal orientation, and the Tri-State Regional Planning Commission has displayed an increasing coastal emphasis particularly in the island's two western counties. The trend is toward increasing recognition of the need for coordination and an ever broader multi-county look at the interrelated marine problems and opportunities along this heavily populated coastline.

How Long Island accommodates to coastal recreational needs may provide useful insights for other growing metropolitan areas along the nation's coasts.

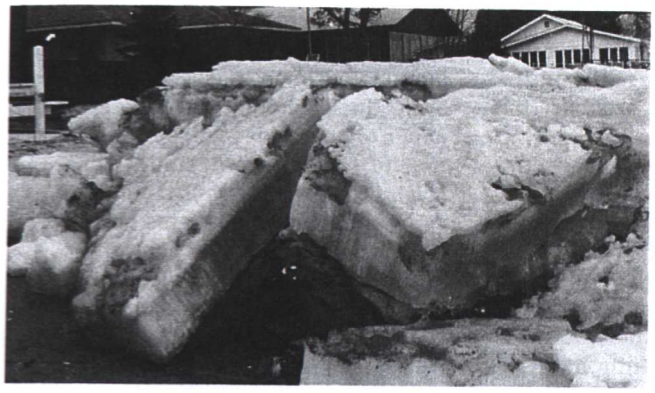
Michigan

Michigan's 2,900 miles of coastline represent over 60% of the total U.S. share of the Great Lakes shores. About 85% of the State's backshore—the shoreline above the ordinary high water mark—is privately owned. Nearly 60% of the backshore is agricultural or undeveloped, about a third is residential, and the remaining 10% is about half parks and half commercial-industrial. Over a third of the State's coastline is highly erodible. During the last quarter of a century, the annual rate of shore regression in these erodible locations has averaged from one to five feet. Damages to shorefront property totaled about $35 million (in 1970 dollars) in the worst year, 1951–52, when lake levels were high. Current high lake levels are also causing severe damage.

Michigan views its shoreland as an unique natural resource that requires an increasing amount of state-level planning and management for its protection. Specific emphasis is being placed on minimizing shore erosion damage and preserving fish and wildlife areas. General attention is being given to minimizing conflicts of use and managing the shoreland for the public good.

Individual initiative in combatting shore erosion along the Great Lakes is often not sufficient as these photos illustrate. Note for example how ineffective the concrete rubble has been; it has probably accentuated the erosion on all sides of it.

Ice is both friend and foe, causing shoreline damage and protecting the shore against wave action.



This concept is reflected in the State's Shorelands Protection and Management Act of 1970 (Act 245, Public Acts of 1970). The act focuses on "high risk areas" (areas of the shoreland which are determined by the State's Water Resources Commission on the basis of studies and surveys to be subject to erosion) and on "environmental areas" (areas of the shoreland determined by the State's Department of Natural Resources on the basis of studies and surveys to be necessary for the preservation and maintenance of fish and wildlife habitat). The State will delineate these areas and develop engineering and management solutions to the problems there in the first year of the plan. These determinations are to be made available to local government which is expected to zone the areas in a compatible manner within three years. The local zoning must be approved by the State. The act also gives the State very broad authority to promulgate rules to regulate the use and development of these areas.

In addition to this focus on erosion, and fish and wildlife in delineated areas, the act also requires the state to prepare a broader plan for the use and management of the State's entire Great Lakes shoreland. The plan will include the usual inventory of shoreline characteristics and uses, problem identification and recommended solutions "to foster the widest variety of beneficial uses." The plan will also provide for necessary enforcement powers and various criteria for protection, shoreland layout and alteration control, and future legislation pertaining to efficient shoreland management.

The Michigan approach may be characterized as a rapid focusing on preservation in precisely delineated areas, within a broader planning and management context. Possibly at the loss of some comprehensiveness but of great advantage in providing some needed simplicity, the delineated areas for zoning are confined to 1,000 feet inland from the ordinary high water mark. The State has fixed this high water mark by law to the nearest tenth of a foot vertically along each of its Great Lakes. Along the foreshore, lakeward of this mark, the State has title and regulates the use and development of its bottomlands. Along the backshore, landward of this mark, the State now has the above-mentioned zoning and rule-making authority in the delineated areas. To what extent the zoning authority can be used without constituting a taking has not yet been tested in court. Neither has the full extent of the rule-making power been defined and tested by administrative and judicial processes.

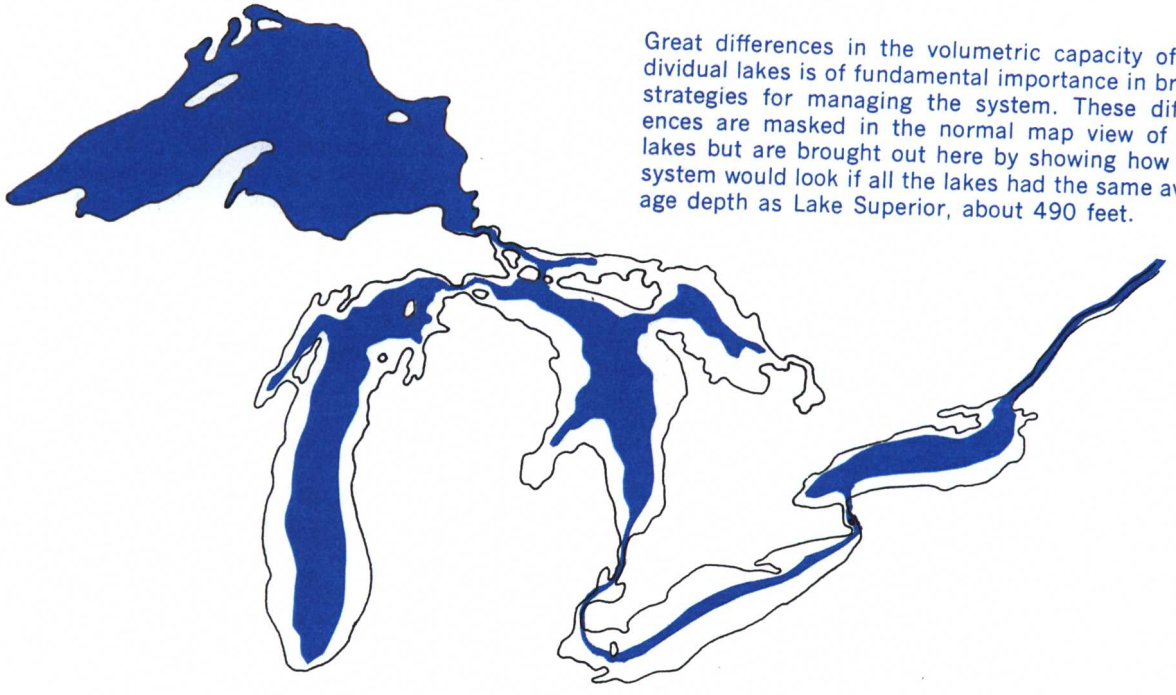
When applying principles, problems and techniques of coastal zone management to the Great Lakes System, some important distinctions have to be made for this, the largest surface body of fresh water in the world. These distinctions include the system's international aspects, relative size, depth limitations on shipping, and susceptibility to icing, pollution and eutrophication.

When focusing more closely on shore protection and enhancement, as these guidelines are doing, distinctions such as geology and lake levels are especially relevant.

• **Geology.** The Great Lakes are basically a unique, geologically-young river system. They are a consequence of the last ice age and took their present form and outlets only about 5,000 years ago. They have a relatively small, immaturely developed, upland drainage pattern, no real estuaries or barrier islands, and relatively few coastal wetlands. The system is still in a process of rapid geologic change and its shorelines have not developed the resiliency to natural forces found in older systems. Rapidly eroding bluffs and upland areas are quite common especially along shores exposed to prevailing winds and waves. The long-term geologic trend is for sediment from inland runoff and shore erosion to fill in the lakes. The full impact of these two sediment sources is not well known, but it is easier to see the relative impact of the filling on the individual lakes. For example, the implications to Lake Erie with an erodible shoreline and only two percent of the system's water volume are much more significant than the filling effect on Lake Superior with its comparatively stable shoreline and 53% of the system's total water volume.

• **Lake levels.** The average water levels in the system vary over years within a range of nearly four feet in Lake Superior to about twice that amount in Lake Ontario. Short term variations produced by a combination of ice jams, seiches, wind setup, storm waves, and wave run-up can raise local water levels as much as 8-10 feet above the current average lake level. When both long and short term variations combine and impact on flat, erodible uplands, the inundation and erosion effects can be particularly severe.

The desirability and feasibility of regulating lake levels is being studied. So far it appears that regulation is technically feasible and that it would be desirable for shoreline stabilization purposes. However, the environmental and economic implications of regulation require much more study. Lake levels, for example, affect dilution capacity and flushing rates so important in water quality control for individual lakes. When cycling between periods of high water and low water, water volume decreases by less than one percent in Lake Superior but by nearly 10% in Lake Erie. "Replenishment time" (total volume divided by outflow) varies from nearly 200 years in Lake Superior to about three years in Lake Erie and about a week in Lake St. Clair.



Great differences in the volumetric capacity of individual lakes is of fundamental importance in broad strategies for managing the system. These differences are masked in the normal map view of the lakes but are brought out here by showing how the system would look if all the lakes had the same average depth as Lake Superior, about 490 feet.

Texas

In terms of coastal zone management, Texas has more options open to it than most states. Partially because of its ample coastline and the historical fact that it was first penetrated and developed from the interior rather than from the coast—"inside out"—the Texas coastline is relatively undeveloped. Population and industry have not concentrated there as conspicuously as in most states, although there are strong trends in this direction. This case briefly describes the development of a coastal zone planning and management framework that anticipates future demands.

Texas is seeking to develop a balanced, comprehensive study and plan aimed at producing an action program and a vehicle to implement it. Such a plan would provide for protection of those resources which must be preserved, wise use of those resources which should be conserved, and the orderly development of those resources which man requires for his industrial, commercial, and urban needs.

Texas' approach closely approximates the general management outline developed later in this guide. It will be described in relation to that outline.

Defining the planning context. The State has assigned this effort to an interagency council, organizationally close to the governor, to promote a horizontal integration of many points of view. A legislative advisory group, a public information-education program, an open conference of experts, and public hearings are used to provide for public participation and reaction. Two major universities are participating to provide continuing research assistance.

Deriving tentative objectives. Emphasis is being placed on long-range study directed toward best use, not just current problem solving. In their planning philosophy the determination of needs and the setting of objectives are a first priority con-

Padre Island National Seashore stretching 80 miles along one of Texas' barrier islands.

A breakwater serving navigation, boating, sportsfishing, and beach preservation.

As enunciated in Texas' Open Beaches Act, Gulf-front beach can be private property down to the line of mean high tide, but this private property is generally open to public use as far as 200 feet inland from that line or to the "line of vegetation." The desirability and authority to regulate public use such as that shown here is under study.

sideration. The Texas planners oppose the often practiced procedure of amassing vast stores of descriptive data and numerous reports as a prelude to planning. Opinion sampling procedures are being designed to extract from the people the kind of environment Texans really want. With meaningful objectives developed, inventories of resources and studies will follow. There is a strong belief that unified action will be more readily achieved through a shared sense of common purpose than by organizational tinkering.

About 20 task groups are being created, each with the responsibility for identifying and describing its assigned resource area, alternative uses, interactions with other groups and alternative solutions where problems and conflicts are identified.

The task groups will address (1) resources such as land and climate, minerals and mining, water availability and wildlife, (2) resource uses such as agriculture, energy and power, transportation, recreation and oceanographic activities, and (3) consequences of resource usage such as land-use patterns, pollution problems, social and economic implications, financial institutions, federal legislation, Texas intergovernmental relations, education, communications and others.

Examining techniques. Both engineering and management techniques are being considered. The legal interpretation of public vs. private ownership of shoreland will be given prominent consideration.

Formulating a shore plan. Since the aim of the study is to develop an action program, enabling legislation has to be a major part of the implementation. The relative strategic and use-oriented roles of State and local governments are being weighed. To this end, all existing authorities are being examined in relation to desired activity areas. Gaps, overlaps, and coordination inadequacies are to be identified, and alternative institutional structures related to needs are to be developed and ranked in terms of administrative and political feasibility.

Implementing the shore program. Whatever institutional pattern emerges, the intent is to give it a continuing capability of reappraisal and readjustment.

The Texas approach to coastal zone management is very comprehensive, and ambitious and well-conceived. A major effort will be required to turn its promise into reality. Continued strong official and public support will be essential.

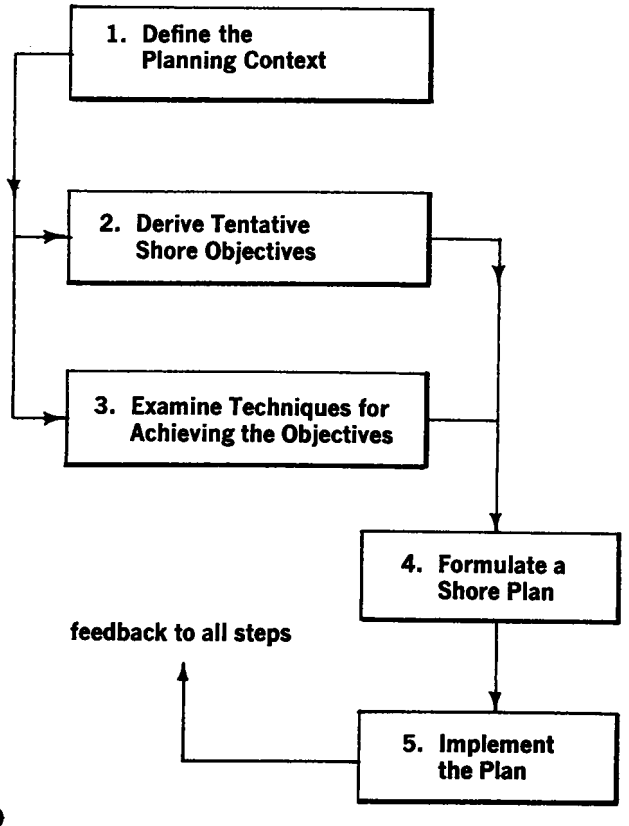

MILWAUKEE

Part 2 A Shore Management Procedure

Part 1 highlighted some *examples* of shore management problems and approaches as they actually exist, without much evaluation.

Part 2 will now examine a shore management *procedure* that can assist those who make decisions (1) to evaluate the need and feasibility of preserving and enhancing their shores, and (2) to develop and implement a plan for doing so.

For coherence these questions will be considered sequentially in five discrete steps. As the simplified diagram below indicates, however, some of the steps can be developed in parallel. Feedback will be prominent throughout.



Step 1. Define the planning context. Shore planning can be accomplished at many different levels with different degrees of comprehensiveness and answers to the basic questions above can vary with the beholder. Therefore, the first step in planning is to determine the scope of the effort and develop a team and apparatus of a breadth commensurate with this scope. Considerations here include the levels of government, the participants and a means of coordinating them, public input, balance, research ties and leadership.

Step 2. Derive tentative shore objectives. To evaluate the shore's importance in relation to people's wants, it is helpful to back off somewhat from the shore itself and see it from a broader point of view. The further one backs off, the more comprehensive the viewpoint, but the less the focus; the shore can become too obscure. The point of view chosen here is coastal zone management—that arena in which all the major uses of the coastal zone, now and in the projected future, are brought into relationship with the coast's physical, chemical and biological regimes and with man's socio-economic and political systems. From this broad perspective, major coastal zone uses can be seen as recreation and aesthetic appreciation; the extraction of living and non-living resources; waste disposal; transportation; residential, commercial and industrial development; and ecological use. Tentative shore objectives worthy of further evaluation in the overall planning process can be derived by considering:

- The *demands* imposed by each of the major coastal zone uses;
- The *requirements*, in terms of desirable shore conditions, to satisfy these demands;
- The adequacy of the shore (*supply*) in

meeting these requirements. The *Regional Inventory Reports* will be helpful here;

- The *needs,* in terms of deficiencies to be overcome.
- The harmonizing of these individual needs into a set of *objectives* that are generally compatible with all major uses.

Step 3. Examine techniques for achieving the objectives. To satisfy these objectives, a number of engineering and management techniques must be examined.

- Engineering techniques deal with the physical interaction of water and shore. They include such things as beach nourishment, dune stabilization, vegetative cover, breakwaters, jetties, groins, bulkheads, revetments, seawalls, dikes, ditching, dredging and filling, upstream dams and water diversions, and hurricane barriers. Since they are examined in some depth in *Shore Protection Guidelines,* they are considered here only enough to bring out their major capabilities, limitations and possible side effects of importance to shore management.
- Management techniques are employed to influence people in their use of the shore. They include voluntary acquisition, agreements, property taxes, cost sharing, planning maps, policies for protection of private property, zoning, subdivision regulations, building codes, ordinances, permits, orders, and various types of condemnation. They are considered here in greater depth than the engineering techniques and their most important legal implications are cited.
- Both engineering and management techniques can be employed for either preservation or enhancement. Frequently several techniques are used in conjunction to achieve an objective.

Step 4. Formulate a shore plan. The plan should include a priority oriented list of who should do what to meet which shore objectives, where and when. To the extent applicable, the plan should also indicate the additional legislation, funding, powers and institutional adjustments that will be necessary. In this guide, a shore plan is developed in three phases. In each phase public input will be essential in making acceptable judgments.

- For each objective, identify feasible engineering and management techniques that can be used to achieve the objective. Evaluate the techniques in terms such as costs, external consequences, time requirements, and organizational and legal implications.
- Fit all the objectives and associated courses of action into a coherent set. This may call for some readjustment of the results of the previous phase to conform to the interrelated priorities, sequential relationships, timing, costs, benefits, lead times and funds available.
- Synthesize as feasible. For example, a closely related set of individual objectives might be brought together under an encompassing objective to establish a seashore park. As a further example, an examination of the program at this stage might lead to some organizational adjustments. At the completion of this phase, final shore objectives and a plan for achieving them are adopted.

Step 5. Implement the shore plan. The plan can set the pattern in varying degrees of breadth and detail depending upon its purpose. But the payoff lies in how successfully it is applied, especially in the light of emerging knowledge and changing circumstances. No matter how well the planning process is carried out, all difficulties in executing the program will not have been foreseen and provided for in the plan. These unanticipated difficulties are fed back into the continuing planning-implementing cycle.

These five sequential steps and their internal development were chosen for their usefulness in developing a shore program in a comprehensive way. Other steps and sequences could be used, but the perspectives and possibly the results would be different. For example, it will be noted that Steps 2 and 3 are approached here by looking first at what kind of shore is desired, measuring the existing shore in these terms and then seeing what techniques are helpful in meeting any deficiencies. Alternatively, one could either begin with techniques and look for places to apply them or first determine what is eroding and then see what can be done about it. Furthermore, for a less comprehensive approach or a single purpose objective—such as to save a house from falling into the sea—it certainly

would not be necessary to bring into play all of the interrelationships developed herein. Instead, the techniques which appeared promising would be identified and followed up in more detail.

Each of these five steps will now be developed in greater depth.

STEP 1: DEFINE THE PLANNING CONTEXT

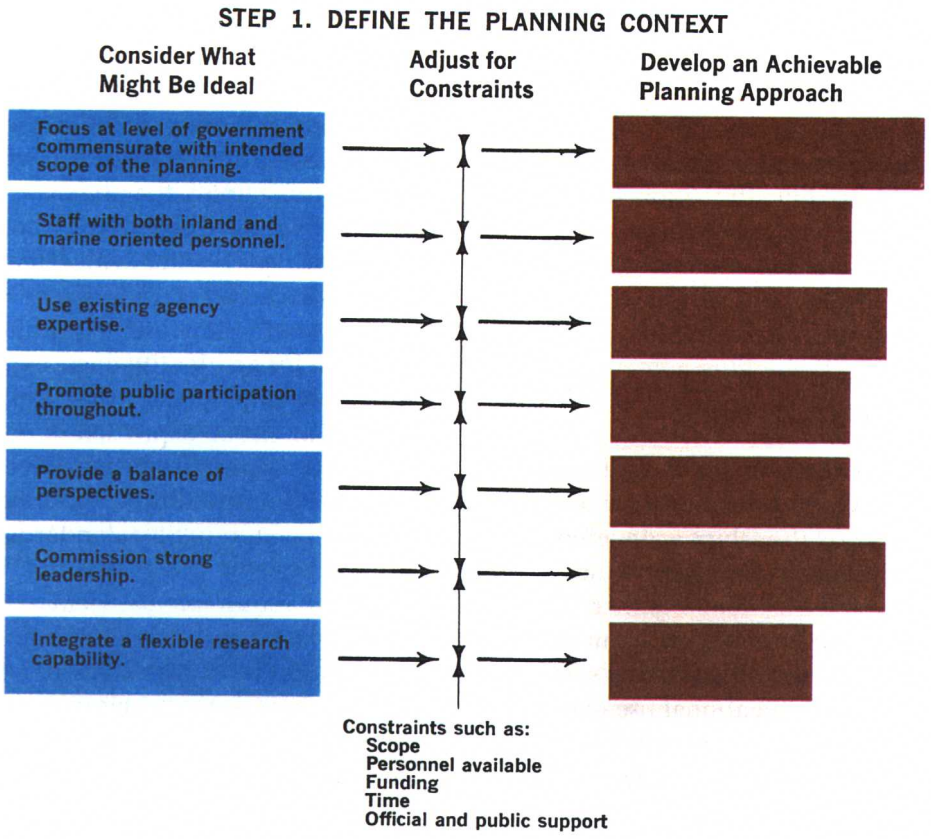
Depending upon its scope and purpose, shore planning can be carried out at many levels. The planning "team" can be a solitary individual responsible for a small project, for a single use or for a current local problem—or the planning team can be a large interdisciplinary group concerned with developing comprehensive, large-scale, multi-use, long-range plans for a region. All levels have their purpose. In the many everyday decisions that must be made, it is not at all practical to achieve a "complete" understanding before every decision to act or not to act. That is a major contribution of comprehensive planning—to take the broad, interrelated view and establish a framework and perspectives within which individual decisions can more easily and confidently be made.

The context illustrated in these guidelines is a comprehensive one—to see how the preservation and enhancement of the shore can play a part in satisfying a broad spectrum of coastal zone uses. The intent is to minimize the suboptimization that could result if the shore were not viewed as a part of a larger context.

The planner whose scope is narrower can make his own tradeoffs between comprehensiveness and the realities of his own planning context. For example, a comprehensive approach might call for extensive efforts to induce public participation and reaction, but an individual planner might choose to obtain this input and feedback more simply by airing his emerging conclusions before a representative municipal board or by inviting comments on his drafts from several sources. Instead of launching a supporting research program to unravel certain unknowns as might be done in comprehensive planning, the individual planner might base his plan upon current,available knowledge and propose a monitoring program as a basis for making later adjustments. Alternatively, if he finds that the consequences of some decisions are irreversible, he may recommend that action be postponed. Where his context is single purpose, he might focus primarily on, say, the recreational beach or living resource portions of these guidelines—*after* he has scanned the other parts of these guidelines to increase understanding of how his own context might fit into a larger one.

Since shore management can best be developed within the broader context of comprehensive coastal zone planning, these guidelines will now offer some thoughts, outlined in the accompanying diagram, for developing a team to do that kind of planning.

- Focus at a level of government commensurate with the intended scope of the planning. For comprehensive coastal zone planning, the focal point is often at the state level with considerable support from federal, regional and local levels.
- Staff with both inland and marine oriented personnel. The shore, by definition, belongs to the oceans and to the land. When shore planning is placed entirely under either domain, essential perspectives are lost. River basin planners, for example, could have a tendency to neglect the special requirements where the rivers reach the oceans, the marine planners could have a tendency to limit inland options severely by establishing unrealistic requirements at the estuary. What is needed is a blend. Tradeoffs, based upon a full exchange of inland and marine knowledge and perspectives, are important in any really comprehensive coastal plan.
- Use existing agency expertise to the extent practicable. In the coastal zone, as everywhere else, many agencies will have key roles. Some realignment of functions might be desirable; however, most states active in coastal zone planning have chosen to defer major organizational decisions until the planning process gives them better insights. The planning is often coordinated by an interagency planning committee or by a lead agency.
- Promote public participation throughout. Strong public interaction is important from



those whose interests are directly affected and from those who appear to represent less direct public interests. This is especially important in the early "listening" stage to learn people's wants and later to assist in evaluating alternatives and formulating courses of action. Participation by organized non-governmental groups representing conservation and industry should be sought. Equally important is input from less organized groups such as land owners and coastal recreationers. Participation here is more difficult. Advisory groups, public information and education programs, public hearings and sampling techniques are useful in reaching and interpreting these less organized groups. So important is the need for public participation, that it is often wise to assign someone on the planning team specifically to sustain it. Plans that are not substantially influenced by informed public participation are usually not politically viable. They tend to be filed on bookshelves.

• Provide a balance of perspectives. As used here, balance means the application of preservation, use and development perspectives to all major uses of the coastal zone. It is a sought-for by-product of some of the broadened participation suggested above.

• Commission strong, high-level leadership to assure action. As important as the requirements for broad participation may be, they can result in a very democratic anarchy; someone must lead the team. As may be inferred, the thought here is that this leadership be of a coordinating type. It should be at a high enough political level to receive the necessary support. This need to achieve broad participation and still produce conclusions and results is one of the most difficult tradeoff decisions that must be made in any comprehensive planning effort.

• Provide flexibility to perform research on unanticipated problems as and when needed. A foundation stone of comprehensive coastal planning is knowledge. Many important knowledge gaps can be foreseen and a means of resolving them can be built into the planning mechanism from the beginning. During the course of the planning, however, other important but unanticipated knowledge gaps will undoubtedly

be uncovered. To resolve a substantial number of them expeditiously as they are uncovered, it is useful to have a prearranged flexible means of calling upon an existing research capability. If the bridge between ongoing planning and research is made too difficult to cross administratively, a plan can easily degenerate into an excessive succession of recommendations for "further study."

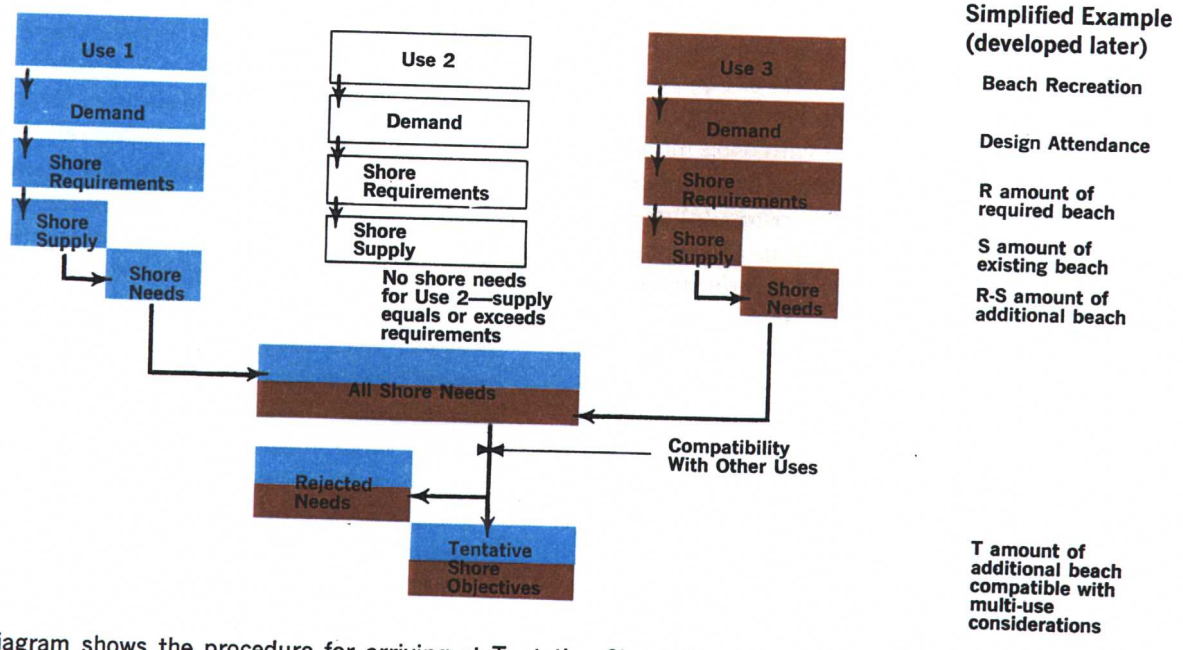
STEP 2: DERIVE TENTATIVE SHORE OBJECTIVES

The shore relates to each major coastal zone use in different ways. One sometimes-used way of bringing out these relationships is developed here. The idea is to consider each use separately at first and then evaluate them together. The process is outlined in the accompanying diagram and description and then illustrated in some depth for one type of recreational use—beach recreation. The aim here is to permit the planner to strike his own balance between the need for comprehensive treatment that, for all its advantages, can become undigestibly complex, and the need for a practicable simplicity. As the subsequent treatment will illustrate, there are varying levels of sophistication with which the planner can employ the process.

Tentative shore objectives whose attainability is worthy of further evaluation in later steps can be derived by considering:

- *Demand*—the present and future aspirations of people for an identified use expressed in terms commonly employed for that use. For example, demand might be expressed in user days or design attendance for beach recreation, in fish catch for living resource extraction and in approved water quality standards for waste disposal.
- *Shore requirements*—demand converted into related shore conditions. For example, requirements might be expressed as an amount of beach of a certain type that can satisfy a level of recreational user day demand, or inlet or wetland conditions that can contribute to a desired

STEP 2. DERIVE TENTATIVE SHORE OBJECTIVES



The diagram shows the procedure for arriving at Tentative Shore Objectives in a case where three uses are involved. For each of the uses the planner would proceed down the diagram with entries comparable to those for Beach Recreation as shown in the right column. In the schematic it is assumed that Use Number 2 is adequately provided for by the present shore, so it is not reflected in the "All Shore Needs" box. The selection of Tentative Shore Objectives at the bottom of the diagram assumes that the satisfaction of some needs was in conflict with that of some whose fulfillment was more important, so they had to go unsatisfied.

fish catch, or inlet conditions that may affect flushing characteristics of importance in satisfying water quality standards. This translation of demand to shore requirements frequently requires ingenuity and research, but it is critical to subsequent analysis. This is particularly true for ecological requirements. While the general demand for ecological preservation and enhancement is apparently great, scientific studies may be necessary to translate this demand into related shore conditions.

- *Shore supply*—the condition of the shore in terms consistent with the above-derived shore requirements. It might be a descriptive inventory of pertinent shore conditions. The *Regional Inventory Reports* will be helpful here.
- *Shore needs*—a deficiency: shore requirements less shore supply.
- *Tentative shore objectives*—a set of shore needs that are generally compatible when considered in relationship with all major coastal uses for the area in question. Some tradeoffs and adjustments will almost always have to be made at this point. Public input will be especially useful.

Beach Recreation

Beach recreation will be considered in some detail for illustrative purposes. With this example in mind, the development of the other uses will be much less specific, focusing only on key points such as the translation of demand into shore requirements.

Demand. Beach recreation demand is usually expressed in terms of designed attendance—the peak number of people who can be expected to be on the beach simultaneously during a selected day, say the 5th or 10th busiest day of the year.

The most popular form of beach recreation is swimming. Outdoor summer swimming currently attracts about a billion participant days annually throughout the nation, and this total has been projected to double by the year 2000. How much of this total may be attracted to the ocean and Great Lakes shores is not known, but the amount is apparently very high. On Long Island, for instance, annual beach attendance is currently about 70 million. In that example, a way was cited for evaluating the demand for beach recreation in a more detailed manner than is developed here.

In another earlier example, San Diego was seen as experiencing a rapid increase in demand for beach recreation. For at least several decades the city has viewed the demand for beach recreation in light of anticipated rapid growth in population, leisure, affluence, mobility and changing tastes. Its total beach attendance, in user days, increased from about two million in 1962 to over five million in 1968. By 1980 and 1990, 7 and 12 million are expected respectively. Currently about a third of the users come from outside the county. Attendance peaks seasonally with two-thirds in June, July and August; daily with 40 percent on weekends; and hourly from noon to 3:00 P.M. For design purposes, San Diego uses the 10th busiest day of the year, Long Island the 5th. Design attendance is the number of people who can be expected on the beach simultaneously on this day. It varies widely with local experience and is often established by aerial photos or attendance records. San Diego uses a low 33 percent of the day's total attendance. On the major beaches on Long Island, 80% is a more typical figure reflecting the observation that bathers there spend more time at the beach once they have reached it.

For in-depth analysis, demand can be related to levels of beach availability and the efforts people must expend to participate. If the water could be made fit for swimming, if mass transit could be routed by the beach, if a divided-lane highway could be run there, if more parking spaces could be provided, if good public beach could be provided on *both* sides of the barrier island, if the gravel or mud could be covered with sand, if the private beach could be acquired for public use, etc.—how much additional beach recreational experience would the people enjoy? With some difficulty, estimates of the significance of these "ifs" can be obtained. With them, the decision maker has an additional tool for evaluating alternative strategies. As some of the "ifs" are intended to illustrate, it may very well not be the beach itself but some other more or less easily resolvable obstacle, such as transportation or parking spaces, which may turn out to be the most significant.

Shore requirements. For beach recreation, shore requirements are usually taken as the amount of beach of a stipulated quality required to accommodate the demand. To translate this demand into shore requirements, density standards in the form of square feet per user for the design attendance are frequently employed. It is easy to "solve" an attendance "problem" by reducing these standards until increasing congestion reaches a level where it, of itself, deters further attendance. In San Diego, the approach has been positive—to *attract* more recreationers to the beach by maintaining a realistic but liberal standard (100 square feet of beach per person for the design attendance) as an important index of the quality of the experience. Acceptable beach densities vary from as low as 20 square feet per person to as high as 300 square feet per person, depending upon regional user experience.

One of the many inland factors that can influence beach use is off-beach service areas. San Diego, for example, requires a square foot of service area for parking and other public facilities for every square foot of beach. Space occupied by dunes is in addition to either the beach recreation or service space.

With projections of future beach recreation attendance and acceptable beach density standards it is possible to estimate the *quantity* of beach of the desired *quality* in proximity to demand locations for benchmark years in the future. Under the terminology, adopted here, these estimates express shore requirements.

Shore supply. For beach recreation, shore supply can be expressed as the area of useable public beach by general location, existing now and projected for the future. In determining shore supply, the *Regional Inventory Reports,* supplemented by local inventories, are useful. The reports include maps and data depicting beach locations, erosion history, shore ownership and basic use for each major reach of the nation's marine and Great Lakes shoreline.

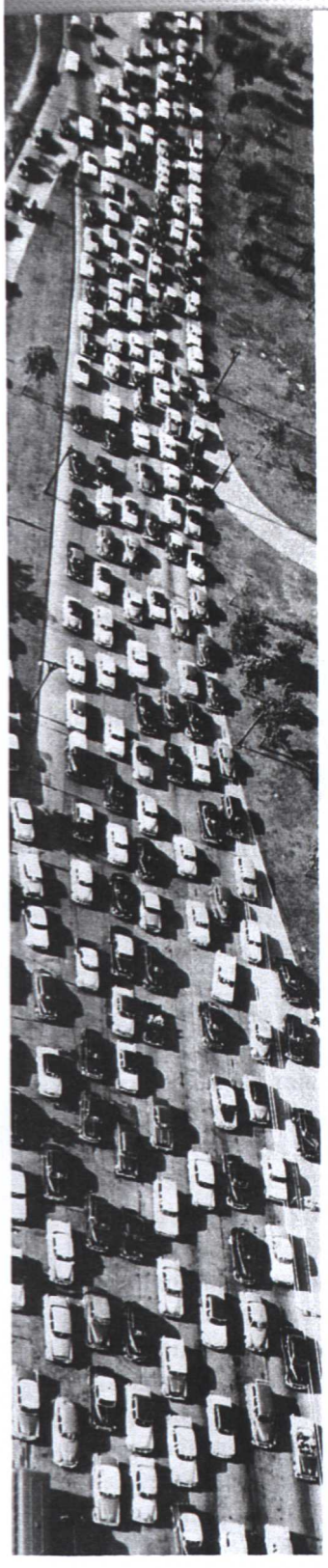
Shore needs. Shore needs are determined by subtraction—the requirements for beaches less their supply. The subtraction is straightforward because the requirements and supply have already been developed in compatible terms.

Other Types of Recreation and Aesthetic Appreciation

Observance of an appropriate brevity precludes the repetition of the entire process for each type of shoreline recreation. For boating, sports fishing, hunting, and other types of recreation the same step process would apply—demand, shore requirements, shore supply and shore needs. Conceptually, the same path applies to aesthetic appreciation, but particular imagination will be needed in establishing and maintaining the low density standards frequently required by this use.

In the key step of translating demand into shore requirements, shore requirements for these uses can be conceived in terms such as:

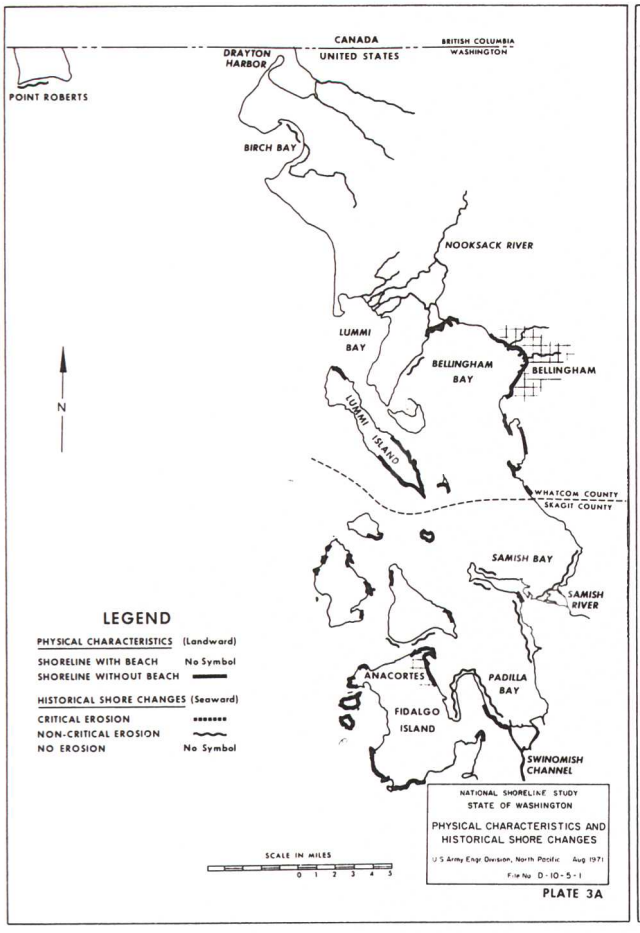
- For boating, an amount of protected water surface with adequate marinas and points of access especially near population centers. Further distinctions can be made, if desired, for various classes of boats. For example, a shortage of boat ramps might limit the use of a waterbody for small craft. On the Great Lakes, it has been found that only the largest, most expensive craft will venture more than five miles from a harbor of refuge even in fair weather.
- For sports fishing, an amount of extensive, remote, well-vegetated wetlands and shoal areas, especially if they are exposed to salt water by frequent inundation and ample internal channels. Again, further distinctions can be made, if desired, for various species, bottom conditions, protected fishing areas, shoreline fishing points, underwater reefs and the like. Sports fishing can also benefit from improvements made primarily for boating, provided that ecological implications are respected.
- For hunting, an amount of extensive, remote, well-vegetated wetlands, especially if they are inundated by fresh water. Other conditions can also be developed.
- For aesthetic appreciation, a length of extensive undisturbed shoreline observable from reasonably accessible vantage points. Other non-scenic forms of aesthetic appreciation such as historical areas, to the extent that they can be identified, can be reflected in terms of shoreline requirements with some imagination. A developed shoreline can also have aesthetic appeal;

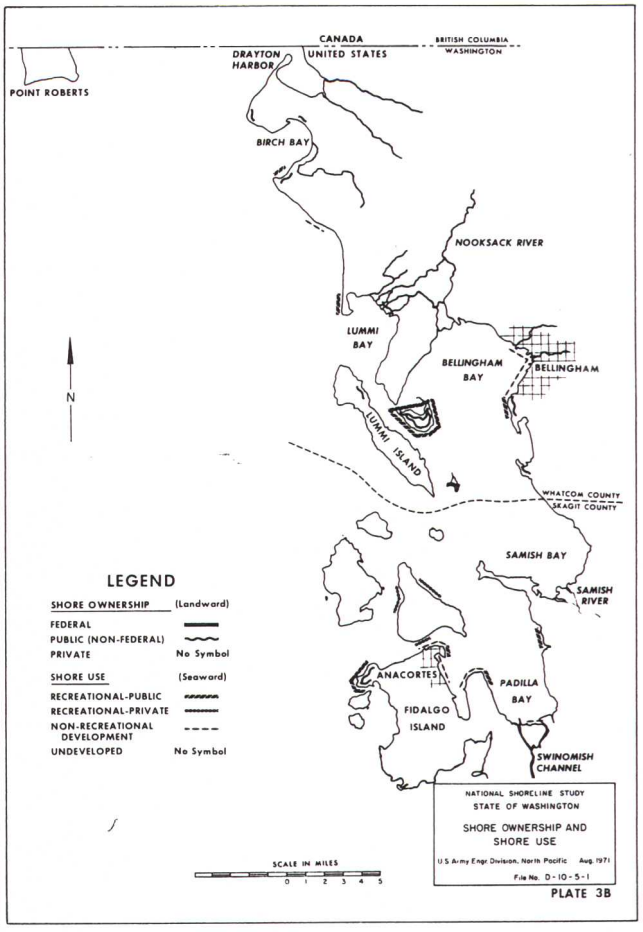


On the way to the beach. The intensity of demand for "free" beach recreation is reflected in the "price" these people are willing to pay for it.

Wallis Sands State Beach, Rye, New Hampshire. Beach density is about 100 square feet per person.

Getting ready for a day on the Sound. An inexpensive shoreline improvement like this boat launching ramp can open up coastal waters to many.





Type of information contained in the **Regional Inventory Reports.** These plates are for the northeast shore of Washington above Puget Sound. Similar information with a supporting narrative is presented in these reports for the entire coastline of the United States.

small craft and commercial harbors and waterfront restaurants are examples.

Living Resource Extraction

The principal living resource extracted commercially from coastal waters is fish. To begin to relate demand for a certain level of fish catch to shore conditions, it is useful to recall that about two-thirds of the commercial fish caught nationally spend an important part of their life cycle in estuaries, whether spawning, nursing, foraging or living there, or just passing through. This estuarine dependence varies greatly. It is about 20 percent in New England, 70 percent in the mid-Atlantic states, 90 percent in the Gulf and almost none along the Pacific, with the important exception of the anadromous salmon. It is easy to find this oft-used relationship for any area. The U.S. Bureau of Commerical Fisheries publishes very detailed information on the fish catch and can indicate which of the locally caught species are estuarine-related. If the knowledge is available or reasonably ascertainable, more sophisticated relationships, such as the outflow of nutrients, may be developed.

The value of the fish catch in the planning area, its estuarine-relationship and the importance placed upon marine life in general, all may indicate an important general demand for increasing resource.

Biologists characterize most estuarine ecosystems as vital and fragile—very sensitive to small changes. Reacting to these findings, inland river basin planning is giving increasing attention to conditions of the river mouths. An example is comprehensive planning for the Susquehanna, the largest river basin along the East Coast. Changes in the flow of freshwater from the Susquehanna into Chesapeake Bay can affect the bay's oyster crop which thrives between certain salinity limits. The upstream reservoirs proposed by the federal-state planning team for the early-action phase of the comprehensive plan will dampen the annual monthly extremes of high and low flow into the bay by only about one-half and two percent respectively.

A number of backbays are vulnerable to much larger, more sudden and more lasting changes than these. From New York to Mexico, for example, almost the entire Atlantic-Gulf coast consists of barrier islands fronting backbays of one type or another. A severe storm washing over one of these barrier islands can open new inlets and thereby radically change salinity, currents, tidal ranges, temperature and other basic environmental factors in the previously sheltered backbays—with important consequences to marine life.

Responding to considerations such as these, biologists might determine, at least in a gross way, the ecological significance of breaching the most important barrier beaches. Engineers might estimate the frequency of major storms and evaluate the adequacy of the existing beach and dune system to resist breaching. Deficiencies would become shore needs.

Conditions at existing inlets may also be important to marine life in more subtle ways. Even normal littoral drift can shoal these inlets, thereby reducing the venting of the backbay system to the ocean with consequent ecological effects. Some marine biologists feel that the currents at inlets can impede the vital passage of larvae and fish into the backbay.

Many other relationships can be translated into shore needs that express possible deficiencies in shore conditions of importance to marine life. Examples are the need for (1) saline or freshwater wetlands and shoal areas, (2) vegetative cover, (3) access channels to wetlands for spawning and feeding fish, and (4) turbidity controls.

Proceeding in this way to the extent judged rewarding, a list of shore needs could be derived which would reflect the type of shore preferred for the preservation and enhancement of marine life in a key fishery area. How deeply one pursued these approaches would be influenced by judgment as to the overall importance of marine life in the planning area and the ability of marine biologists to define the relationships even in a gross way.

Non-Living Resources

If the general demand in the planning area is very high and inland sources are scarce, an inventory of offshore minerals and other living

resources may be justified. An example is sand and gravel. Increasing shortages for construction and beach nourishment may be projected in some locations, especially near urban areas. If its extraction should prove environmentally and economically feasible, it might satisfy important needs.

Waste Disposal

Considerable quantities of wastes of many different types stem from municipal, industrial, agricultural and natural sources. Much of the waste enters streams either directly through man-made disposal systems or indirectly through natural runoff, precipitation of airborne contaminants and other processes. When major water courses enter the sea, usually at estuaries, some of the pollutants dissipate into the sea, but some concentrate sluggishly in the estuaries. Thus a plotting of water quality gradients in coastal areas will almost invariably show that the pollution is concentrated primarily in the poorly flushed, finger-like, sub-estuaries near major urban areas.

The strong public demand for water of high quality is made more tangible to those who are trying to respond to this demand when it is expressed in the form of approved water quality standards. These standards are derived after study, hearings and review to reflect an agreed-upon tradeoff between the need to dispose of wastes and the quality required for other coastal uses.

The condition of the shore usually does not play a major role in satisfying water quality standards. However, in some special circumstances, the protection of silt-clay shorelines from erosion can reduce turbidity and, as previously pointed out, shore conditions around inlets can affect the flushing of estuaries. For example, the second entrance to San Diego Bay is currently being investigated to improve flushing in that bay.

Transportation

Marine transportation is one of the principal uses of the coastal zone. Most consider it to be the major reason why the nation's seven largest metropolitan areas are located on the coast. Despite its importance and its critical dependence upon shoreline conditions, especially as they affect key approach channels and loading areas, these guidelines will not dwell on deriving shore needs for this use. Shore conditions important to marine transportation can be extracted from local port studies. For a fuller treatment of such things as major channel deepening, offshore islands, and platforms to serve regional needs, much more complex regional studies will probably be needed. (*Ref. 12*)

In some cases, the shore offers attractions as a locale for major airports and coastal highways, but the land-use, social and environmental considerations require special studies beyond a scope that can be even outlined in these guidelines.

Marine transportation is one of the principle uses of the coastal zone.

Residential, Industrial and Commercial Development

Residential demand for shore space is increasing rapidly, particularly for summer homes. For example, many lots which sold for about $500 in 1955 now command $15,000 on Cape Cod. Shore needs particularly applicable to residential development might be expressed in terms such as land suitable for building purposes and:

- Adjacent to the oceanfront especially with a beach large enough for the resident's use and for storm protection but inaccessible enough to discourage mass public use; or
- With a sweeping view of the sea; or
- Adjacent to channels leading to waters desirable for boating and fishing.

Needs such as these can be expected to become increasingly more prominent as projected changes in population, affluence, leisure, mobility and environmental appreciation exacerbate demand for a vacation home along the water.

Industrial and commercial demand can sometimes be expressed as shore needs in terms of useable land adjacent to deep water to facilitate the transportation of bulk materials or in terms of useable land adjacent to protected shores and offshore currents to facilitate waste diffusion and assimilation.

Ecological Use

A shore in a natural state undisturbed by man is often valuable for ecological balance, an important use of the coastal zone not always given adequate attention. The complexity of the land-sea interface in terms of both its living and nonliving characteristics and their interrelationships is generally acknowledged. The sensitivity to change of some aspects of this environment has been delineated, but the general resiliency of the system is an unknown quantity. A change in shore conditions, whether caused by man or natural forces, can set off a chain reaction of events which will detrimentally affect this total balance.

From this important ecological point of view, all shoreline conditions which affect this balance are important. Man-induced changes in the natural state, such as filling in a wetland or mining sand from a dune, should be evaluated for irreversible or significant ecological impacts. To reflect the demands of ecological balance, special studies are usually required *before* such changes in shoreline conditions are made.

One way of focusing attention on ecological balance is to delineate especially sensitive coastal areas and factors. Michigan is following such an approach. An inventory of current ecological conditions and the relevance of shore conditions in these areas—and elsewhere as well—is best done by life scientists. Their input to the planning process could be of the nature of "this type of change will affect these species at these locations and times in this way." The changes may benefit or damage the ecosystem or be inconsequential. Changes in the ecological balance, whether caused by man or by natural forces, can affect not only non-human life but man himself in ways that are only beginning to be understood. Sometimes a natural area might benefit if it is protected from extreme natural changes such as drought conditions that trigger fires in the Everglades.

Maryland and Louisiana provide two examples of how both man and natural forces can affect ecological balance. Maryland has estimated that it has been losing its coastal wetlands in the past three decades at the rate of nearly 400 acres a year—about 0.1% of the state's 307,400 acres of wetlands. A quarter of this loss is ascribed to natural erosion and natural succession and the remainder to man primarily for landfill, dredging, spoil disposal and agricultural drainage.

According to some observations, about 10,000 square miles in the Mississippi River Delta is rising in some locations and subsiding in others with an estimated net annual subsidence of about 16 square miles. In cases such as this, it is not easy to see whether the demand for ecological balance means a hands-off policy or a search for remedial actions based upon better knowledge of cause and effect. What is clearer is that inundation and salt water intrusion, whatever the cause, will change the existing ecological balance.

The demand for suburban residential development along the shorefront is illustrated here by the efforts made to multiply the natural shoreline and the willingness of these residents to squeeze together to enjoy its still-limited extent. Where important public ecological values may be affected, zoning and permits are two managerial techniques that can be used to control development. Where a compromise between residential development and ecological uses is judged desirable, cluster-and-open-space zoning and high-rises are sometimes considered.

At Rookery Bay near Naples, Florida, the Conservation Foundation, the Nature Conservancy, the Audubon Society and the Collier County Conservancy are cooperating to develop a plan that fully respects ecological considerations but also incorporates a variety of residential, commercial, recreational and commercial facilities as well.

Tentative Shore Objectives

Procedures up to this point can produce a set of shore needs each of which is coupled with the demand to which it relates. A listing of all these needs and related demands will almost certainly contain numerous incompatibilities. For example, it is highly unlikely that inlet conditions needed for boating, fishing, waste disposal, marine transportation and ecological balance will coincide. The need for more "reclaimed" land near the shore to satisfy residential, commercial and industrial development demand will undoubtedly not coincide with the need for wetlands to satisfy the demands of commercial and sports fishing, hunting, and ecological balance.

Some tradeoffs based upon scientific knowledge and the relative significance of the individual demands should be made here. Public expression, fully exposed to the significance of the choices involved, is most important. Final resolution of particularly difficult tradeoffs, however, might be deferred until after evaluation of the various techniques examined in the next step. Some apparent incompatibilities might be mitigated, for example, by the judicious application of selected engineering and management techniques.

Two examples of the type of shore objectives that might be tentatively accepted at this point are:

- So many more million square feet of public beach in this general area by a certain year to accommodate so many people for beach recreation.
- So many acres of wetlands with these characteristics by a certain year to benefit wildlife in this way.

STEP 3: EXAMINE TECHNIQUES FOR ACHIEVING THE OBJECTIVES

In Step 2, tentative shore objectives, whose attainability was judged worthy of further consideration, were derived. In Step 3, two principal classes of techniques for achieving these objectives are now to be examined—engineering techniques and management techniques. Both classes may be useful in preserving and enhancing the shore in such a way as to help achieve shore objectives. Engineering techniques can do this by influencing the physical interface of land and water. Management techniques can do this by influencing people in their use of shoreland and coastal waters.

Both classes of techniques will be examined here in enough depth to bring out the principal capabilities, limitations and external effects which should be considered before employing them. The examination of engineering techniques will be relatively brief because they are developed in much more depth in *Shore Protection Guidelines*. The examination of management techniques will be in greater depth to include a number of legal considerations.

Although it is necessary to consider each technique individually here, in practice they are usually best employed in conjunction with each other. It might be possible, for example, to achieve a shore objective for improved waterfowl areas *either* by management techniques such as acquiring and posting more wetlands, *or* by engineering techniques such as diking to improve the ponding of fresh water in already acquired wetlands. In practice, both might be applied. In another common example, engineering techniques might be employed to preserve or enhance an existing dune system and management techniques might then be employed to control public and private use of the dunes to maintain their quality. To satisfy an objective for more public beach, engineering techniques might be employed to stabilize an existing beach against erosion or even to create a new beach. Management techniques might be employed to acquire more beach or improve access to existing public beaches.

Engineering Techniques

Stabilization. For objectives which call for stabilizing a shore, these engineering techniques might be helpful:

- *Beach nourishment.* When the objective is to mitigate erosion losses or storm-induced inundation, periodic beach nourishment is an increasingly attractive and effective solution. Sand is pumped or placed on the beach to widen it and flatten its profile, thereby reinforcing its natural ability to attenuate wave energy. The most significant effects of this method are possible disturbances at the borrow area. These effects can be minimized by careful source selection. Of the several sources usually considered, offshore bottoms probably can provide sand with the least ecological changes, but at significant cost.
- *Dune stabilization.* When the objective is to reduce flooding or limit catastrophic shore regression induced by high tides and storm surges or protect a backbay ecosystem from sudden change caused by storm-cut inlets, stabilizing existing dune systems might be an effective technique. Dunes may be stabilized or enlarged by adding vegetation, wind fences or sand directly. If sand is imported, ecological considerations at the borrow areas should be evaluated.
- *Vegetative cover.* Shorelines with a high silt and clay content and exposed to relatively minor erosion forces can sometimes be stabilized by planting and nurturing selected grasses. This method is most likely to be effective along backbay shorelines, not along the ocean front. Side effects appear minimal except when the vegetation traps littoral drift and consequently contributes to the erosion of the downdrift shoreline.
- *Breakwaters.* When the objective is to protect shores from erosion caused by waves and swells or to create relatively calm inshore waters desirable for boating, fishing and navigation, breakwaters are sometimes used. Sand accretion on the shoreward side of the breakwater and consequent downdrift starvation are possible external effects which can be mitigated by sand by-passing.
- *Jetties.* Where it is desirable to stabilize inlet dimensions and the rate of water exchange

STEP 3. EXAMINE TECHNIQUES FOR ACHIEVING THE OBJECTIVES

ENGINEERING TECHNIQUES—Influencing the physical interface of land and water

Stabilization

- E-1 Beach nourishment
- E-2 Dune stabilization
- E-3 Vegetative cover
- E-4 Breakwaters
- E-5 Jetties
- E-6 Groins
- E-7 Bulkheads, revetments & seawalls
- E-8 Dikes

Development

- E-9 Ditching & diking
- E-10 Dredging & filling
- E-11 Upstream dams & water diversions
- E-12 Hurricane barriers

MANAGEMENT TECHNIQUES—Influencing people in their use of the shoreland and coastal waters

Agreements

- M-1 Voluntary acquisition
- M-2 Private agreements

Public Policy Inducements

- M-3 Property taxes
- M-4 Cost sharing
- M-5 Planning maps
- M-6 Protection of private property

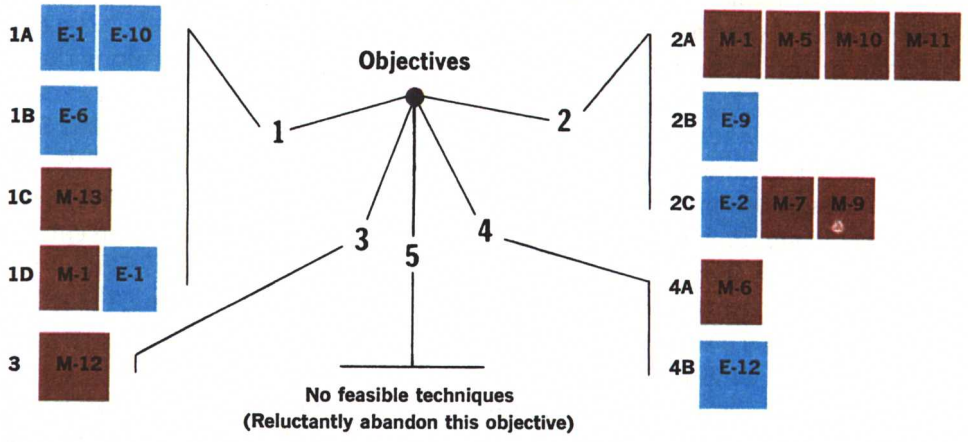
Regulatory Controls

- M-7 Zoning
- M-8 Subdivision regulation
- M-9 Building codes
- M-10 Ordinances
- M-11 Permit
- M-12 Orders

Compulsory Taking

- M-13 Condemnation
- M-14 Inverse condemnation

FEASIBLE COURSES OF ACTION



Select feasible courses of action to accomplish each objective. A course of action may employ one or more engineering or management techniques or a combination of both.

between the ocean and backbays for a variety of recreational, navigation and ecological reasons, jetties can be useful. They can cause sand accretion on their updrift side and consequent erosion on their downdrift side unless some transfer mechanism is employed. Some feel that jetties can also increase or limit the movement of fish and crustations into estuaries, but this effect has not been authoritatively established.

• *Groins.* When it is desired to maintain or increase the sand at a particular location to improve the recreational characteristics of a beach, groins have been used. Although groins do trap littoral drift, they may do so at the expense of erosion downdrift of the groins. This effect may be offset by groin design and by periodically replenishing the sand between groins or downdrift therefrom.

• *Bulkhead, revetments and seawalls.* When the objective is to protect high-valued facilities that must be located adjacent to the waterfront, these three devices should be considered. Certain designs can minimize but probably not eliminate the tendency for sand to be scoured away from their face. These devices can also protect bluffs from eroding. Where it is desired to preserve marine life dependent upon rocky bottom conditions near the shore, these devices may be preferable to other methods such as building up a protective beach. One of the adverse effects of bulkheads is that they inhibit swimming.

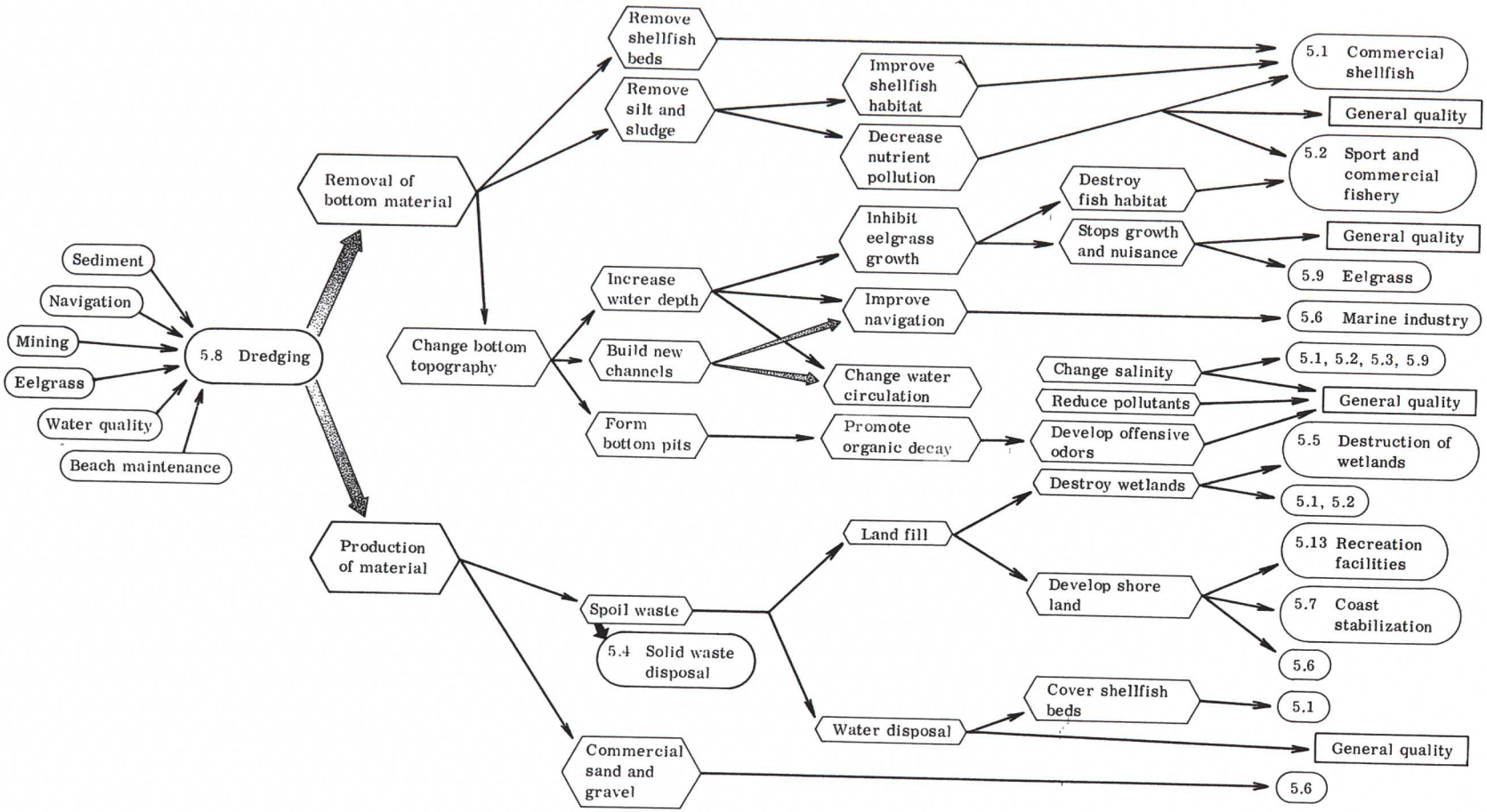
• *Dikes.* When the objective is to protect inland developed areas or ecological systems from inundation, dikes may be employed, especially if there is no natural dune system. Their disadvantages lie primarily in possible ecological impacts in borrow areas and the inducement they might create to develop lands which might better be left undeveloped, considering the risk of inundation.

Development. When an objective calls for developing the shore by modifying existing shore conditions, the techniques listed below should be considered. What is considered enhancement for one use may often be considered degradation or opportunity foregone from the point of view of another use. This section merely indicates what can be done by engineering techniques to achieve certain objectives, the desirability of which is evaluated elsewhere. Most of the techniques considered under stabilization can also be applied here with some modification as the previous examination occasionally implied. To avoid duplication, these techniques will not be reexamined here.

• *Ditching and diking.* These techniques can be used to enhance marshy backbay shorelands for a variety of purposes, not always complementary. Waterfowl habitats can be created or enhanced by diking off salt water to provide fresh water impoundments. Ditching can open up fish access to wetland areas that are valuable as food sources and as spawning and nursery areas. Where pesticides are considered undesirable, ditching and diking can be used for mosquito control purposes by draining or flooding wetlands or permitting natural predators such as minnows to gain access to mosquito larvae. Spoil placed alongside ditches has been used to increase the muskrat fur harvest. Side effects are apparent— what may be good for one species can be bad for another.

• *Dredging and filling.* Dredging can enhance navigation, boating and water circulation by deepening water courses. Filling can enhance if new shoreland is desired. A combination of dredging and filling can improve the shoreline for developmental purposes. A prime example is a finger-type real estate development. Through its canals and adjacent landfill, it can provide new waterfront property to many more people. Undesirable side effects, in the form of lost habitat or foraging area or the redistribution of sediment caused by dredging activities, are almost all borne by fish and wildlife. Although it has been mentioned earlier, it is worth repeating at this point that engineering techniques can be employed to help achieve many objectives, but they cannot be used to determine what these objectives should be. For example, if deep holes are found to be beneficial or detrimental to different fish, as some suspect, or if more mudflats are desired, dredging and filling can accommodate to the objectives selected or even be designed to attain them.

• *Upstream dams and water diversions.* When



A NETWORK ANALYSIS OF DREDGING

Every engineering and management technique for achieving every shore objective can affect other objectives—greatly or insignificantly, for better or for worse. Some of the major possible side effects are cited in these guidelines. For in-depth analyses, some very detailed and intricate environmental matrices have been developed in California and elsewhere. The network analysis shown above was developed to analyze some of the interrelationships between dredging and a number of uses, activities and objectives on Long Island. Other relationships could be added and similar networks could be developed for other techniques—if the scope of the planning justifies this level of professional attention. Source: Ref.5

used for flood control, navigation, low flow augmentation, sediment control and stabilization of salinity gradients, these devices usually enhance or do not appreciably affect shoreline uses in highly developed urban areas often found at river mouths. When they dampen out the extremes of high and low freshwater inflow, they may benefit some marine species and harm others. When they reduce sediment flow, they may improve water quality, reduce shoaling tendencies and protect benthic life from being smothered occasionally, but they may also reduce the supply of nutrients beneficial to this life. Where river-borne sediment contributes significantly to the natural resupply of beach sand, upstream dams and water diversions can cause shoreline erosion near their river mouths. The current patterns may also be changed and thereby alter shore erosion and accretion patterns. Solutions to shore problems occurring near the outlets of rivers should consider what effect these upstream actions might have on the immediate shore problem.

- *Hurricane barriers.* When the objective is to protect high-valued exposed urban property and minimize human suffering and possible loss of life caused by inundation, hurricane barriers might have special application. They are very expensive and they have possible external effects which should be evaluated in any decision to use them. They might accent the normal storm surge on their seaward side. They will alter currents with possible effects on erosion, accretion, salinity and marine life conditions. They can provide safe havens in storms but impede navigation at other times.

Management Techniques

The engineering techniques just examined helped meet shore objectives by preserving or enhancing the physical interface of land and water. Another class of techniques now to be examined, management techniques, is useful in meeting shore objectives in another way—by influencing people in their use of land along the shore. Like engineering techniques, each management technique has its own capabilities, limitations and side effects that should be considered before employing it.

In applying management techniques, a governmental agency must meet six legal tests:

- Authority to support its actions must be legally delegated to it.
- The action must be in pursuit of an objective appropriate to the agency's level of government.
- The action must help reach this objective.
- All individuals subject to a regulatory system must be treated equally.
- Private property must not be taken without compensation.
- Decisions must be made in accordance with procedural requirements of a full and impartial hearing where private interests are affected.

Basic management techniques for shore areas do not differ essentially from techniques employed for land-use management elsewhere. However, their application is often of special importance along the shore because of some complex and unique natural and human interactions there:

- The common use of water areas for a wide variety of purposes such as navigation, fishing, recreation, cables, and pipelines.
- The diverse multiple uses of the shoreline that depend upon the condition of the adjacent land and water areas.
- The dependency of the ocean's marine life on estuarine ecology.
- Uncertainties as to the boundary between public and private ownership and usage rights in some areas.
- Difficulties in obtaining public access to publicly owned shorelines.
- Very high land values along the shore especially near urban areas.
- A moving shoreline—caused by erosion, accretion and shoreline recession and advancement —compounds ownership and usage problems.

The basis for decision-making varies with the part of the shore being considered. In the foreshore—the part of the shore generally held in trust by the state for the public welfare—decisions are based upon what is judged best for

the public, even when the exposed or submerged land is leased or sold for private development. Over 80% of the backshore in the contiguous United States is private property. Here decision-making must consider both the public welfare and the rights of individual property owners.

The boundary between the foreshore and backshore is usually set on or near the ordinary high water mark, but the actual boundary locations, related rights and legal interpretations vary considerably from state to state. In examples at the beginning of this guide, Miami Beach, Texas and Michigan each had different concepts that had conspicuous effects on decision-making. Even when a principle is widely held, its application can be legally difficult. For example, in Miami Beach backshore property expands with natural accretions and contracts with natural erosion, but the government and the riparian owners have widely different interpretations on what is natural and what is man-made.

Most of the management techniques examined below apply primarily to the backshore. In providing for the public welfare, governments usually consider it good policy and good economics to employ the minimum amount of authority necessary. The management techniques are therefore grouped into four classes that reflect a gradually increasing imposition of public power over individuals.

- Agreements
- Public policy inducements
- Regulatory controls
- Compulsory takings

Agreements. Agreements can be between government and individual as in various forms of acquisition or they can be between private individuals.

- *Voluntary acquisition.* Under this technique, ownership or certain rights are obtained for an authorized public purpose by donation or by purchase at a price acceptable to both parties. Acquisition in fee simple confers complete ownership and usage rights. It is therefore the most straightforward, legally clear method. With one minor exception, San Diego acquired all the area for its aquatic park at Mission Bay by fee simple and has been free of any significant ownership and property rights problems ever since. Acquisition in fee simple, however, can be very expensive. Instead of outright ownership, government can acquire lesser rights to use private property or to limit its use by the owner. Through acquisition of scenic or historic easements, restrictions or development rights, the cost of acquisition can be reduced and land can be left in private ownership and on the tax rolls. The National Park Service has found that the scenic easements it requires cost only about a quarter of the appraised value of the fee simple. Sometimes costs can be reduced by purchasing only part of a land holding and paying the owner severance charges. Unfortunately, easements and severances charges can often cost almost as much as fee simple. When a need can be foreseen for property in the future, several little-used techniques with considerable potential are (1) fee simple combined with leaseback, (2) discount bonds and (3) the purchase of options. Under a variant of the first technique, the National Park Service has successfully acquired land in fee simple, reserving to the owner a life estate in the improvements. Discount bonds are a means of deferring the payment of both interest and principal to a later date when the benefits of the land holding are expected to be realized. The third technique involves the purchase of an option to acquire property in fee simple for a specified price at a future date. This technique might be useful when a need for additional public beaches is foreseen at some future time, say the year 2000. It may be much less expensive, even when interest is considered, to purchase this option now than to purchase the property later in a highly developed state. In the meantime, until it is needed for public purposes, the property can continue to be used for, say, residential or other private purposes. Because of possible legal implications, these three techniques may require special authorization, possibly from the legislature.

- *Private agreements.* Neighborhood groups can voluntarily by "contract zoning" protect themselves and promote the best use of their

property. This tool is useful in areas where development has not begun or is in a very early stage, and where local or higher agency regulatory procedures have not yet been accepted.

Public Policy Inducements. Shore objectives can often be satisfied by public policies that indirectly influence the way people use shore property. Major policies of this type relate to property taxes, cost sharing, land use planning and protection of private property.

• *Property taxes.* Almost all coastal communities employ property taxes to provide funds for their services. The taxes can be levied in ways that will contribute to very different objectives. When property taxes are tied to the "best use" of land under a zoning system, property owners will be induced to develop their land up to this level or sell to someone who will. If property tax levels are tied to actual use, property owners will feel less pressure to develop. To encourage special uses and actions critical to a master plan, preferential tax levels can be levied and taxes can be deferred or waived. Methods such as these are employed to preserve open space or encourage conservation measures; however, in so doing they can also encourage the speculative holding of land. For example, an owner might willingly cooperate with a plan for a green belt area around a city by keeping his land in essentially tax-free pasturage—until urban development in the vicinity raises the market value of his holdings to an irresistable level. Furthermore, the deferment or waiver of taxes on wetlands may not have a great inducement effect since wetlands are usually assessed at a very low rate. For example, wetlands constitute 4.8% of Maryland's total land area but account for only 0.2% of the state's total assessed land valuation.

• *Cost sharing.* This can be a very effective inducement to meet some shore objectives. Three principles of cost sharing are widespread benefits, indivisibilities, and user charges. When the benefits of a proposed action, such as beach acquisition or public development, are judged to be sufficiently widespread, higher levels of government often recognize a responsibility to share the cost under various formulas. When an action must be performed in concert or not at all (an indivisibility), such as restoring a long reach of beach as a whole or acquiring an ecological preserve, the cost must be shared somehow. When benefits can be pinpointed, user charges should be considered; however, the administrative cost of collecting these charges often eats up most of the revenues gained. In return for sharing the cost, higher levels of government frequently exact binding agreements to assure that the benefits are indeed widespread. As the Miami Beach example emphasized, the federal contribution to shore protection projects is heavily influenced by the degree of public access and use. Federal cost sharing policies for these projects are explained in *Shore Protection Program* (Ref. 13). Many states also have cost sharing policies for shore protection projects. The San Diego example showed how the federal, state and local governments shared the development costs and how rental from leasees provided enough income to operate the park. In Michigan, most of the erosion areas were delineated and the engineering solutions were conceptualized by joint federal-state participation in the *Regional Inventory Report* for the Great Lakes. Funds from the Sea Grant Program, the Department of Housing and Urban Development, the Water Resources Council and other federal agencies are contributing to some state and local coastal studies.

• *Planning Maps.* Maps which depict a planned allocation of the shore for public uses, such as wildlife refuges, beaches and parks, can greatly influence future development in these areas. Public discussion and approval of these plans inevitably creates uncertainties among private property owners regarding the use they can make of their property. In most instances, government will not have the resources to purchase these areas outright or even determine precisely their extent and location. But the responsible governments anticipating ultimate acquisition are anxious to avoid major increases in future acquisition cost caused by increasing development. The difficulty is complicated

further when private owners are anxious to develop their lands and when methods mentioned earlier, such as fee simple-and-lease back, discount bonds and purchase of acquisition options are not available. A partial solution to this problem may be to require all owners desiring to develop their land to seek specific permission to do so from the appropriate authorities. If the request is denied, the property owner should be awarded compensation for losses sustained by the denial, with payment for the entire value of the property deferred until the government is actually ready to use the land for public purposes. In some states there may be legal problems with this separate taking of development rights.

• *Protection of private property.* To induce private property owners to protect their shorelines in a way that benefits the public interest, previously mentioned tax and cost sharing policies may be applied. Often special authorizing legislation will be necessary. Attempts to force a shoreline property owner to take measures at his own expense to protect his shoreline might be unconstitutional. Certainly, it would be a sharp departure from existing practices. On the other side of the coin are the problems of finding ways to charge private property owners for the benefits they derive from shoreline protection or enhancement measures taken by government. Usually a state can construct shore protection devices in the areas below high tide without the owner's consent. If the owner consents to the improvements, no fundamental problems arise, but if the improvements are made without his consent, allocating the costs to contiguous shoreline property owners is legally questionable.

Regulatory Controls. Shore objectives can often be satisfied by directly controlling the use of both private and public property. Regulatory devices that do so are founded on the police power of government to protect the health, safety, morals and general welfare. For the police power to be employed, an appropriate legislative body must have found in fact a need for the particular exercise of authority and

SUMMARY OF GENERAL POLICY OF STATE PARTICIPATION IN SHORE PROTECTION PROJECTS—NORTH ATLANTIC STATES

State participation—portion of non-federal share	States
Federal Projects	
100%	Delaware (Each project must be approved individually by the State Legislature)
50%	Massachusetts, Connecticut
70%	New York
75%	New Jersey
*	Maryland
No specific programs	Virginia, Rhode Island, Maine, New Hampshire
Other Projects	
100%	Delaware (Each project must be approved individually by the State Legislature)
67%†	Connecticut
50%	Massachusetts, Rhode Island
75%	New Jersey
70%	New York
*	Maryland
No specific programs	Virginia, Maine, New Hampshire

* Interest-free loans to municipalities made by State of Maryland.
† For publicly owned shores. For privately-owned shores the state pays one-third.

SOURCE: Regional Inventory Report, North Atlantic Region, U.S. Army Corps of Engineers, 1971.

articulated its terms in legally sufficient detail. Important regulatory controls considered below include zoning, subdivision regulation, building codes, ordinances, permits and orders. Considerable flexibility in their application is possible.

• *Zoning*. By-laws generally establish zoning districts and impose restrictions on uses of land, densities, building heights, industrial development and the like. The concept is to control private property uses that may affect the community adversely. The coverage of zoning has been increasing in recent years to require such things as:

1. Large enough lots for water supply and sewage disposal.
2. Setbacks from shorelines. These are established survey lines indicating the limits for certain types of development. Setbacks can be based upon a number of technical, administrative and developmental considerations.
3. Conservancy districts applicable to wetlands and areas subject to frequent flooding.
4. Historic districts with special review for changes in the appearance of buildings.
5. Port and harbor districts.

The zoning authorities have also been experimenting to cover new techniques such as:

1. Direct open space zoning which might include conservation districts and dedicated lands, and
2. Possible zoning of water areas for uses such as boating and swimming.

Limitations in zoning as a technique result primarily from its usually local character which severely restricts the possible impact both spatially and temporally. This deficiency could be minimized by keying the zoning to broad master plans and by state assumption of shoreland zoning aspects that have widespread implications. In an earlier example, Michigan was seen to be following such an approach. The State requires state-level review and approval of local zoning in certain delineated shoreland environmental and erosion-prone areas. A zoning plan can also be made stronger with acquisition of some land use rights at key points on the shore to reduce pressure to alter the zoning pattern. Another limitation on zoning is found in judicial interpretations as to what constitutes a valid exercise of the police power. For example, in many states, zoning for purely aesthetic purposes has been judged not to be legally included by itself in the "general welfare". Aesthetic purposes are frequently upheld, however, if they can be demonstrated to *contribute* to the health, safety, morals or general welfare. The protection of private property is usually found to be in the general welfare. In some states, such as Louisiana, encouragement of tourism has also been considered to be in the public welfare.

• *Subdivision regulation*. Shoreland subdivisions can be required to initiate and maintain provisions for protection of the shore in areas where erosion or storm damage are probable. In addition, requirements may be made as to parks and roads and for the reservation of open shore lands for later purchase by the public. This method has less coverage than zoning as it is restricted to areas to be subdivided. Although Michigan has no zoning powers related to its shorelands other than in delineated high risk area, the state does have authority to review all subdivisions along its Great Lakes shores and impose minimum restrictions to protect buyers from possible inundation.

• *Building codes*. Whereas zoning and subdivision regulations determine the location and some characteristics of permissible structures, building codes deal directly with the construction considerations. In shore areas, some major concerns of building codes should be: adequacy of soils for construction and waste disposal systems, quality of construction necessary to withstand wave and wind damage or tidal flooding, assurance the structures will not adversely alter erosion patterns, and minimum elevations for fill placement. The development of an all-encompassing model shore building code is limited by the varied nature of the shore and the recognition that some buildings are already located in exposed locations and that others must be located there to fulfill their function. Pompano Beach, Florida and Wrightsville Beach, North Carolina are among the communities that have developed excellent

The day after the storm. Setbacks prescribed in codes can require that all development be located a prescribed safe distance from the beach. Note how close these buildings are even to quiet waters. Here man has not lived in harmony with nature. Zoning can be employed to see that he does.

shore building codes to serve their particular needs.

• *Ordinances.* In the absence of state regulations or to supplement them, local governments may pass ordinances to create their own zoning or building codes or to insure consideration of problems not covered by these tools. Ordinances can deal with such things as dune protection, beach safety, tidal inundation, surfing areas, camping on the beach, parking and litter control. In Wisconsin, localities are authorized and encouraged to zone their flood plains including the Great Lakes shore. If the locality does not do so, the state will.

• *Permits.* Where it is not feasible to define usage controls adequately, say where on-the-spot inspection is required or where site conditions may govern, permits may be required. In these instances, a proponent of a development or a land use modification must obtain the approval of a legally designated agent of government. The agent is empowered to hear the facts of the case and to make the decision usually based upon defined criteria and requirements for public notice and intergovernmental coordination. Insofar as modifications to physical shore conditions are concerned, the most significant example of permits is the permit authority of the U.S. Army Corps of Engineers governing the approval of any construction or other actions which affect navigable waters. Stemming originally from the federal authority over navigation this authority has been broadened considerably by subsequent administrative interpretation and court decision to include aesthetics, fish and wildlife, and the general public welfare. In administering this authority the Corps encourages the state to review applications and indicate a position pertaining to fish and wildlife aspects. The Corps also conducts public hearings where warranted, and coordinates with all appropriate federal agencies.

To improve the quality of the more complex permit decisions that must be made, the Corps has consistently advocated strong comprehensive coastal planning particularly at the state level. (The Corps has also recently announced a new permit system that will, in conjunction with other agencies, monitor discharges into navigable waters for water quality control purposes but that permit system is beyond the scope of these *Guidelines.*)

• *Orders.* These are specific demands for an owner or community to comply with an administrative decision interpreting a broader authority. An order may restrict the owner from

performing many actions. The owner then has an opportunity to object if he considers it excessive or a taking, and may be entitled to compensation under some of these circumstances. Orders have proven very effective in Massachusetts' regulation of wetlands. In Oregon, the right of government to enjoin a backshore property owner from fencing off his private property between the mean high water line and the line of vegetation has been upheld in court. It was held that this private property was vested with a customary right of uninterrupted public use for bathing and recreation. Similar rulings have been made in Texas as the earlier example brought out.

Compulsory Taking. Of all the management techniques considered in these guidelines, compulsory taking represents the strongest imposition of public power over individuals. Two forms of compulsory taking are condemnation and inverse condemnation.

- *Condemnation.* Sometimes ownership or lesser property rights required for an authorized public purpose cannot be acquired at an agreeable negotiated price. In these instances, government may exercise its right of eminent domain and acquire the property by condemnation, paying what it unilaterally judges to be fair compensation. The land owner has the right to appeal the decision in the courts.
- *Inverse condemnation.* As has been seen, governments can control the use of private property in the public interest. But when the control so severely limits the use of the property as to deprive the owner of its substantial use, the owner may appeal and courts may require the government to compensate the owner for his losses. The precise point at which the exercise of police powers constitutes a taking is a key legal determination. It varies considerably with the specific circumstances. The manner in which it is determined is beyond the scope of these guidelines.

STEP 4: FORMULATE A SHORE PLAN

The suggestions presented in preceding pages will produce a set of tentative shore objectives, and a list of alternative methods or techniques that might be used to attain each objective. These and other features of each of the courses of action still under consideration must now be examined in the context of the total plan.

The plan can be formulated in three phases illustrated in the diagram.

Phase 1

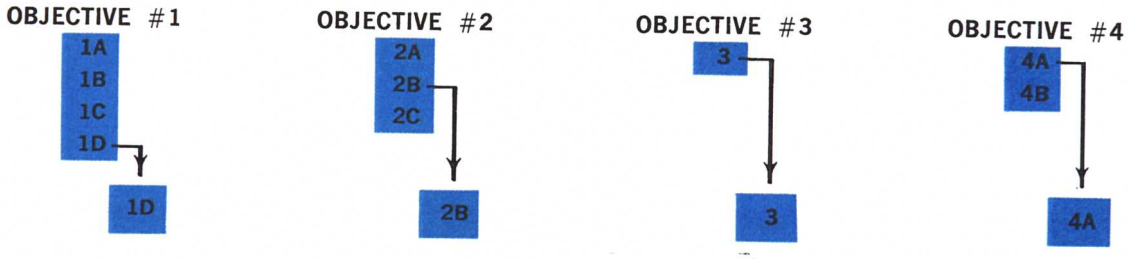
To select a course of action for each tentative shore objective, a matrix can be used to highlight the factors to be considered. In the examples shown, the tentative objectives are listed in the first column, followed in the second column by feasible alternative courses of action. On the line following each course of action are arranged the features associated with it that are significant to the program. Some will require a paragraph, some only a word or a figure to describe. A few have been filled in here to indicate the type of entry needed.

The considerations displayed in the columns can be expanded to any desired degree, but the complexities of analysis will be magnified accordingly. For example, the matrix could display the costs and benefits that are measurable in dollars, and other costs and benefits that are measured in qualitative terms. In an even more complex manner, one could get completely outside the system and have shore values compete with other values such as alternative forms of recreation, social welfare programs and the like. For extremely important proposals it might be necessary to introduce many of these considerations. In most cases, however, the planner and the public must draw a practical line somewhere if any conclusions are to be reached. A guide as to how far to go for any particular plan should be found back in Step 1 where the importance of defining the planning context was stressed.

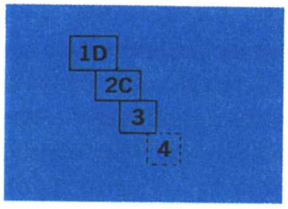
The interactions of external consequences, the conflict or sharing of responsibility among organizations, and information that makes possible an initial evaluation of the feasibility of a program schedule can be displayed in a matrix in an organized array. Obvious conflicts and incompatibilities can be recognized and a first order evaluation of the efficiency of each action being considered can be made in the context of the total program.

STEP 4 FORMULATE A SHORE PLAN

PHASE 1. From the feasible alternatives, select a course of action for each tentative shore objective.

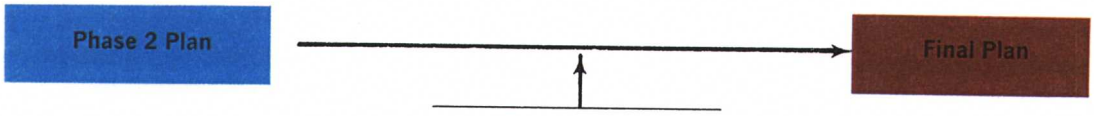


PHASE 2: Fit all objectives and related courses of action into a coherent set.



After considering interrelationships,
1D is accepted without change
2C replaces 2B
3 is modified
4 is dropped

PHASE 3: Synthesize as feasible.



Overview considerations such as:

- Combining individual objectives
- Financing
- Political
- Level of government
- Agency alignment

Connecticut Wetlands Preservation Act

The controversy engendered by one of the first applications of Connecticut's Wetland Preservation Act (69-695) raises most of the crucial legal problems attending the exercise of state police power for shoreline preservation.

Pursuant to the wetlands legislation, the Connecticut Commission of Agriculture and Natural Resources designated 277 acres of privately owned land as protected wetlands. The land was part of the Great Meadow Marsh, a tidal area lying between the Connecticut Turnpike and Long Island Sound next to Bridgewater harbor. Shortly thereafter, the owner petitioned the Commission for permission to fill in part of the marsh and develop it as a deep water harbor and for industrial use. Connecticut law permits property owners to utilize tidelands if such use does not interfere with navigation. After extensive hearings, which were well attended by conservationist groups opposing the development, the Commissioner refused the permit and also rejected a compromise proposal by the owner to develop only 131 of the 277 acres. The owner then brought suit challenging the legality of the denial and the procedures attending the decision. The owner claimed that he has owned the land since 1948 and that the land was zoned for heavy industrial use since 1927. He alleged that he had invested several million dollars in site preparation and rail facilities and that therefore the decision to establish the 277 acres as preserved wetlands constituted an unreasonable exercise of police power. In addition, the owner claimed that he failed to receive a full, fair and impartial hearing.

The Act provides for the appeal of a Commissioner's decisions to the courts. If the court finds that the action is "an unreasonable exercise of police power" it may set aside the order restricting the land's use. If the court finds that the action is the equivalent of a taking without compensation and that the land so regulated otherwise meets the interests and objectives of the act, it may, at the election of the Commissioner; (1) set aside the order or (2) proceed to award damages. The Connecticut act gives the courts very wide discretion and only the vaguest standards for its decisions. The act also requires the complaining property holder to notify all parties having an interest adverse to his own so that these parties may participate in the hearing. Therefore, in this particular case papers have been served on dozens of persons, including many officers or spokesmen for conservation groups in five counties.

The phenomena of very vague standards, intensive public interest, and large financial stakes for the affected property owner is archtypical of the kind of controversy raised by state shoreline protection legislation, particularly where the state attempts to impose severe restrictions on the development of property without offering compensation.

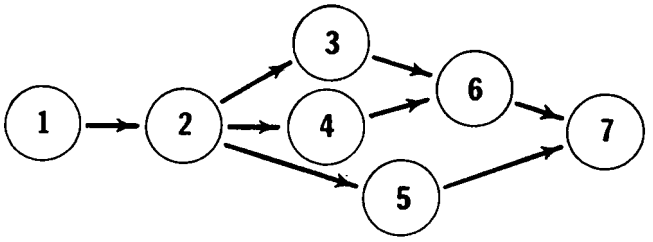
As a result of such analysis, an initial selection of one or a combination of courses of action can be made for each of the tentative objectives such that for this level of detail the selection results in an optimal combination of items under their various column headings, and a set of actions that are not obviously incompatible.

Phase 2

This phase tests the practicality of the combination of the various activities at the level of detail required by a program schedule. Even though some conflicts were weeded out at the end of Step 2, at this point there will probably still be a number of conflicts between the individual objectives. There will also be some interactions between the techniques tentatively selected for some individual objectives and the attainment of other objectives. Essentially all of the information is now available to make the necessary reconciliation. Public participation through devices suggested earlier in Step 1 will be particularly helpful here in making the hard choices which depend so much upon people's values.

Where the sequential relationships between objectives are important factors, a network diagram can be used for analysis and scheduling. A primary consideration in laying out the schedule may be the annual budget, in which case it may prove useful to refer to fund raising devices and sources of money that are discussed later under Financing. In any case, whether it be financial capability or physical necessity that determines the milestones and completion dates, the execution of the program can be scheduled for a specified period that is found to be desirable and feasible through the use of a network diagram.

PERT NETWORK DIAGRAM



In this diagram, event 2 must occur before event 3, and event 6 must occur after event 3. Event 4 may occur either before or after event 3, but it must occur before event 6.

The diagram is what is known as a PERT network, PERT being an acronym for Program Evaluation Review Technique. A member of the planning team can quickly acquaint himself with details and special applications of PERT by referring to one of the many publications available on this subject.

When interrelationships between activities and events are laid out on a PERT network and accompanied by appropriate data, a coherent schedule can be worked out that conforms to time, funding and other constraints and identifies the critical elements of the program.

In constructing a PERT network, one may find that the course of action selected to reach a tentative objective presents problems in scheduling that would not be encountered if an alternative were selected. In such a case, he can return to the planning matrix to examine the alternative again with respect to the total program.

If the alternative is acceptable, he can include it in the PERT network. The development of the program thus becomes an iterative process within the realities of money, legal constraints, time requirements, social impact, politics and property ownership, as tentative objectives are selected and scheduled to become firm objectives in shore management.

Financing. Since funding almost always limits an action program, some special attention will be given to it here. Three useful principles in matching a program to the funds which can be acquired are cost sharing, priorities and scheduling.

Cost sharing was considered earlier as a management technique to motivate lower levels of government or individuals to do something which will help achieve an objective. Here cost sharing is considered in a different light—as a possible source of funds.

A good cost sharing guide is to look in all directions.

- Look upward. A higher level of governmen might have a program to contribute part of the costs if it judges a project to have widespread benefits beyond the sponsoring community and appropriate to the goals of the higher government. Thus the willingness of the federal government to contribute to beach protection for public beaches is tied legislatively to the finding that public beaches are in part national assets worth protecting. The Bureau of Outdoor Recreation with its Land and Water Conservation Fund, the Department of Housing and Urban Development, the Department of Commerce and many other federal agencies have cost sharing programs which are actually inducements to achieve legislatively-affirmed national goals. The federal government publishe a complete listing of these programs. (Ref. 16). Many states also have cost sharing programs which might apply to shore objectives. Consistency with some approved overall plan is increasingly being considered as a criterion for cost sharing.
- Look outward. If a substantial number of individual beneficiaries are outside the sponsoring community, visitor taxes can be considered.
- Look downward. User charges might be considered in the form of licenses or facility fee provided that the cost of collection does not wipe out most of the revenue. Facility charges are particularly appropriate if the cost of the facilities is a high proportion of total costs. For example, San Diego has a plan to improve some of its oceanfront beaches and access thereto to accommodate about 65,000 additional beach

PLANNING MATRIX

Tentative shore objectives	Alternative courses of action	Cost ($ million)	External consequences (possible solution)	Years req'd	Organizational requirements	Legal aspects
3.2 million square feet of public beach in Zone II by 1980.	**A.** Widen narrow beach at A with sand from offshore and lagoon (1.5 million square feet).	$1.2	Benthic life destroyed for 2 years at lagoon (more study or different site?).	3	To get federal support, County Lima required to give required local assurances.	
	B. Prevent further erosion loss at B with groins (0.5 million square feet).	.4	Probable increased erosion at E (redesign groins, fill with sand?).	1	No federal support. Work with downdrift landowner association.	
	C. Open up little used beach at C by acquiring property at Z (2.1 million square feet).	4.1	Reduced aesthetic appeal of existing beach (none?).	8	No change from present.	Ownership rights uncertain (probable court battle).
	D. Create new beach on lagoon at D by providing vehicular access, parking and minor sandfill (1.9 million square feet).	1.0	10 acres of wetland lost (improve management of remaining wetlands?).	1	New role for City Park Department-beach administration.	City lacks authority (pass ordinance).
200 million square feet of Type 3 wetland in Zone IV by 1990 for wildlife.	**A.** Acquire and post wetlands at F (150 million square feet).	.3	Denies use for residential development throughout and 10 acres for proposed public beach at J.	1		
	B. Dike wetlands at G to entrap freshwater runoff and prevent salt water intrusion (100 million square feet).	.1	Denies use for fish (usage zoning?).	2	Association of local property owners needed.	Possible inverse condemnation suits.
	C. Protect wetlands at H from predicted storm destruction by dune stabilization at barrier beach I (200 million square feet).	.1	Restricts dune buggies (acceptable).	2		

Deteriorating port facilities like these are aesthetic nuisances, a source of floating harbor debris and a barrier to other uses of the urban shoreline. The source of this blight can be removed with engineering methods and controlled in the future with management techniques such as permits and building codes.

recreation visitors. About 86% of the $22 million cost is for additional parking spaces. Parking meters are a traditional, easily administered method of transferring a large part of this cost to the users of these expensive facilities.

• Look into the future. It might be judged that some costly current projects are primarily to benefit future generations. To the extent the benefits are in the future, they might be equitably transferred to these future beneficiaries by several management techniques developed earlier: fee simple- and- lease-back; discount bonds; and the purchase of options.

A second funding principle is priorities. Some objectives will be judged more beneficial than others. To achieve them, it may be necessary to forfeit some of the lesser objectives. Or it may be desirable to settle for only partial attainment of many objectives to satisfy even a part of others. Or a less satisfactory but less expensive technique might have to be reluctantly accepted to achieve a low priority objective.

A third funding principle is scheduling. Some objectives might have to be achieved now or never. Others might have to be achieved now because later objectives are dependent upon them. The achievement of some costly objectives might be stretched out in phases, provided that the stretchout does not increase total costs over the long run.

San Diego again provides an instructive example of cost sharing and scheduling. Of the $52 million capital costs to date for the city's Mission Bay project, about 30% was costed upward to the federal and state governments and about 40% was costed downward to the lessees. Annual rental from lessees who own and operate many of the special facilities provides enough to meet all city operating costs. A visitor tax further helps the city bear its costs. Use of the park is free except that those who use the hotels and other special facilities pay for them. Scheduling is used to spread costs in a different way. Development of the largest island in the bay, Fiesta Island, has been postponed until anticipated future demand materializes. This not only spreads the cost to future beneficiaries, but keeps many options open to fit the eventual development to future values which may be different from those of today.

Political considerations. Any plan is likely to have some political problems. They will be related at least in part to the agencies that are in affected areas and to the extent of public involvement before a plan is firmly chosen. Other problems may relate to the extent to which legislation can be passed and the strength of vested interests that have opinion on the program. While the specific problems obviously depend both on the particular objective as well as the particular locality, the process of planning and decision-making should illuminate the potential trouble if an extensive public involvement has been maintained.

Phase 3

In this Phase, the program will be examined as a whole for the purpose of developing overview insights or judgements. For example, by observing the local concentration of projects of a certain type, a planner may decide to wrap them together to establish a new ecological preserve or park. When looking over the total program, he may observe that certain techniques (such as zoning) or certain legal problems (such as boundary uncertainty) stand out. These observations might lead to developing a more united across-the-board approach in these areas because of their observed general significance. Alternatively, a planner might observe that certain endeavors currently receiving much attention do not achieve results of corresponding significance to the program.

Another type of overview consideration is organizational—what adjustments in existing organizations, if any, will improve the execution of the program and its continuous or periodic updating? At this point it is useful to weigh two organizational considerations that should be part of any comprehensive plan: (1) the level of government and (2) agency alignment.

Level of government. In Step 1 it was stated that, for comprehensive coastal zone planning, the state is probably the logical focal point with appropriate support and participation from the national and local levels. With planning nearing

an end, the objectives and activities will be defined clearly enough to give reasons to confirm or modify that concept.

The focus of both property taxation and zoning at the local level might profitably be reexamined at this point. To pay for education, other services and various capital improvements, local governments make tradeoff judgments between the tax revenues that various land uses will yield and the environmental quality of their communities. Each community derives its own equilibrium between the relative values it places upon its public services, environmental quality, economic development and tax levels.

Since the local community does depend so much upon these tax revenues, the tradeoffs made and equilibrium reached will tend to be favorable toward plans and developments that provide revenue. This may be done at the expense of the disamenities produced, especially those of a regional nature such as pollution or degradation of a unique location of special value. Consider a state like Maine with only 60 miles of beach along its 2,500 miles of coastline or New Jersey where one coastal community grows from a permanent population of 830 to 18,000 during the summer. Do coastal communities in locations such as these have an internal right to tradeoff their environmental quality for their own economic or social gain? Those who say no, advocate (1) replacing the property tax with other revenue devices such as redistribution of income tax revenues and (2) moving the power zoning to a higher level, where a wider perspective, more consistent with the extent of the externalities involved, can be asked to make a more informed judgment. On the other hand, there are some essential activities which may be generally unpopular but have to be located somewhere. If the state were to take away all incentive to its localities to accept these facilities, then all localities might assume a put-it-elsewhere posture and the state will have to use force or compensation. Disentangling property taxation and the level of zoning authority can be an extremely complex issue. An alternative is to work generally within the present system: continue zoning at the local level where the greatest impacts of the tradeoff decision are probably felt, but define as precisely as possible the major situations where the external effects of local zoning require endorsement at a higher political level.

With the growing recognition of the existence and importance of external effects in recent years, there has been a trend toward centralization of regulatory power. The state, as compared to the locality, usually has a broader perspective, can be more objective, has more expert talent available to it, and has more money and political clout. (The same, incidentally, might be said for the federal-state relationship).

On the other hand, what the locality may lack in these capabilities, it gains in intimacy. It probably knows more about the circumstances than any more remote level of government, and by its proximity, it is almost certainly more affected by the decision than anyone else, notwithstanding the existence of externalities. Furthermore, if higher government does not limit its own decision-making appetite, it can become hopelesssly involved in detail at the expense of the perspective it claimed in the first place.

A resolution of this dichotomy lies in the principle of delegation of authority. Under this principle, decision-making is pegged at the lowest level consistent with the scope of the problem, but decisions must conform to statewide policy on the issues for which it has been established. Technical expertise at higher levels is thus discounted in favor of greater local familiarity with the circumstances—although higher level expertise is available for advice. Higher authority, being the source of the delegated power, reserves the right to establish the limitations of the delegation. It may delegate decision-making only upon request, or automatically under certain precisely prescribed conditions. Alternatively it may delegate all powers not specifically reserved. The U.S. Constitution is an example here. The delegation may be in law, by administrative policy, by tradition, or by default.

A workable system incorporating the principle of management by exception would place

decision-making at the lowest level commensurate with the anticipated scope of the decision but prescribe the policy framework and the types of external considerations that must be referred to a higher level. "You can act provided you do not_____." The responsibility for filling in the blanks is that of the higher level. The need to do so will tend to keep its attention on these broad effects and articulate their dimensions.

Two approaches embodying delegation of authority and management by exception are (1) dual permit systems and (2) default regulation.

Under a dual permit system any applicant for a development or land use modification must secure a permit from a higher agency (most often the state) after all necessary local government approvals have been obtained. Under this type of system, the state or whatever agency is above the local government has absolute control. The dual permit approach can be cumbersome in terms of staff and procedures necessary for administration. Considerable simplification might be achieved (1) with general regulations that serve to diminish the number of special cases requiring individualized consideration under a permit system and (2) be requiring referral to the state only when certain specified conditions are present.

Under a default regulation system, municipalities qualifying under higher agency or state criteria could regulate use of the local shore in the place and name of the state agency. This approach clearly provides local governments with some power to control the future use and development of their shore areas. A potential problem under this arrangement results if local government fails to act in certain situations that in the view of a comprehensive state plan require action. Local governments would probably need substantial assistance in drafting and adopting adequate codes and ordinances. Data and technical expertise might not be readily available to local officials. There are, however, excellent codes and ordinances in existence which could serve as models for other communities.

With these examples in mind, some broad options for locating regulatory authority necessary to carry out the program may be summarized as:

- State regulation of all land use in all of the coastal zone.
- State regulation in critical shore areas whose preservation or enhancement is especially essential to the integrity of the total shore-use plan.
- Regional administration of a state land-use plan for the shore.
- State intervention and regulation when local governments are unable or unwilling to act.
- Local administration of land-use controls that are in agreement with the state land-use plan.

Whatever option is used, it does appear that eventually some form of control at the state level will be required to assure implementation of a state-wide plan if only to fill a void where land use is not being controlled by local jurisdiction. Available options in this area of regulation and implementation must be considered carefully, for in most states a complete and automatic assumption of strict and unchallengeable land-use controls may stimulate sharp and lasting opposition rather than support in the political arena.

Agency alignment. It may be that the perspectives gained in the comprehensive planning and program formulation up to here justify some realignment of existing and proposed new functions within the state government. Broad alternatives include:

- Assigning the role of shore management to a specific state agency, say, to a department of natural resources.
- Keeping authority in general conformity with existing agency structure and establishing an interagency council with overall coordinating responsibility.
- Creating a new state agency to administer the program, transferring to it most of the functions of existing state agencies that impact on the shore area.
- Making no fundamental organizational changes.

Several criteria have to be considered in determining the most appropriate overall management structure. One criterion must be administrative efficiency. Another is the attitude of both

local and state officials. A third and extremely important criterion is the pattern of existing program administration. Implementation of a management scheme which is foreign to the established administrative format of the state may be cumbersome and unresponsive.

Many view the concept of an interagency council as a most promising administrative alternative. The council would include agency heads or their representatives. It might also well include an associated advisory group of private citizens, local leaders, and representatives of higher and lower levels of government. One fault of councils is that they tend to be less dynamic than individual agencies where authority to act resides. If the council is considered essentially as a means of coordination, leaving action to its member agencies, this deficiency may be acceptable.

Whatever the organizational conclusions, it is wise to avoid the understandable tendency among planners to optimize at the level of their program instead of seeing their program as a piece of something larger. Recommendations for new coastal zone umbrella organizations, for example, may properly come from coastal zone studies, but decisions on these recommendations should come from those who see the non-coastal zone equally well. Continuous attempts to juggle government structure in search of a fault-free shore management system might only succeed in draining scarce energies from more useful pursuits.

Whatever conclusions are reached in this final overview stage, they should be included in the plan along with their supporting rationale.

STEP 5: IMPLEMENT THE PLAN

The plan developed in the first four steps can set the pattern in varying degrees of breadth and detail depending upon its context defined at the outset in Step 1. But the payoff lies in how successfully it is applied, especially in the light of emerging knowledge and changing circumstances.

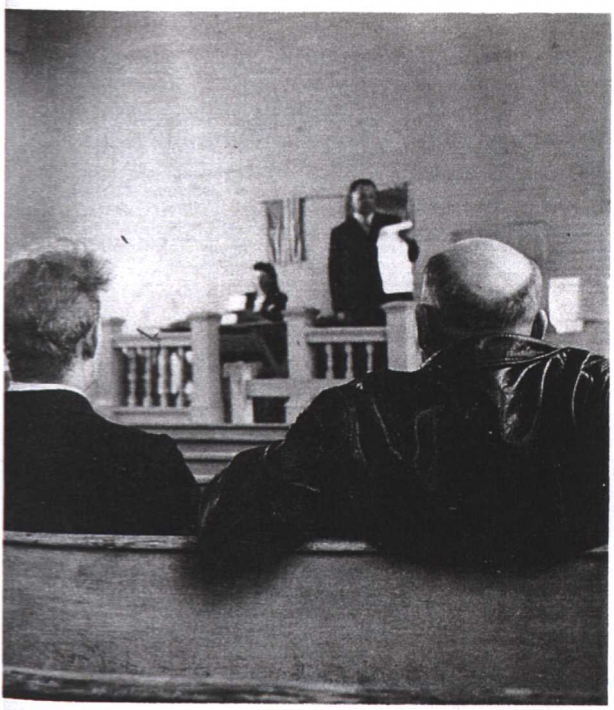
Special problems in implementation such as staffing, operations, rule making, administrative interpretations and enforcement will not be considered here.

The intent throughout has been to anticipate problems of implementation—such as feasibility, financing and levels of decision-making—and factor them into the planning considerations. No matter how well prepared the plan may be, however, some unanticipated difficulties will certainly be uncovered when the program is being executed. Lessons learned during implementation should feedback into the continuing planning-implementation cycle. An action may turn out to have better or worse results than anticipated, public values may shift, administration may require more staff than anticipated, and so on.

Information of this type may require adjustment of current actions and almost certainly will justify adjustments in actions programmed later.

Part 3 **Guidelines**

It is clear from the foregoing that comprehensive planning must be instituted in the management of the shore if this national resource is to be preserved so that it can continue to perform its critical natural function in the ecological balance, and at the same time provide the many necessities and benefits that we have come to expect from it. Guidelines for planning a program to improve the use and management of the shore are summarized here briefly to reconstruct for the reader the sequence followed. The methods employed give recognition to the essential interdependence of planning and regulation, and aim at a judicious combination of managerial and engineering techniques to accomplish desired results.



Provide for means of informing the public and employing public response and support throughout.

DEFINE THE PLANNING CONTEXT

Each shore management program is situated in its own unique complex of institutional, governmental and industrial organizations, with its own types of shore problems. Effective planning can best be undertaken when the planner has a clear initial picture of the organizational environment within which he must operate, and when he deals with it appropriately. Some principles that have been successful in the past are listed here.

- ***Focus at a level of government commensurate with the breadth of the projects*—usually at state level with appropriate national, regional and local participation.**
- ***Employ existing agencies that have the knowledge and authority and structure an interagency mechanism with both inland and marine interests.***
- ***Provide for means of informing the public and employing public response and support throughout.***
- ***Include flexibility to perform research on unanticipated problems, or to have it performed when needed.***
- ***Commission strong, high-level leadership to assure action.***

DERIVE TENTATIVE SHORE OBJECTIVES

• ***Evaluate demands made upon the shore by all major uses***

Although few uses are as amenable to quantified analysis of their demand as is beach recreation, the demands that other uses place upon the shore are clear, and can be described in terms of utility of the shore to their purposes. Additional work in establishing standardized measures of demand for each use would be worthwhile. Major uses to be considered are:

- Recreation and aesthetic appreciation
- Living resource extraction
- Non-living resource extraction
- Waste disposal
- Transportation
- Residential, commercial and industrial development
- Ecological use

• ***Evaluate the supply of shore to meet these demands***

Refer to *Regional Inventory Reports* and conduct a local inventory.

• ***Determine needs***

Identify needs in terms of deficiencies where supply does not satisfy demand.

• ***Select tentative shore objectives***

Select from the needs those that appear worthy of more detailed consideration.

Consider all the selections together and screen out or trade off obvious conflicts and inconsistencies.

Describe the surviving requirements with sufficient precision and detail to permit courses of action for satisfying them to be developed and evaluated.

Call these derived, broadly screened, surviving, sufficiently defined requirements "tentative shore objectives."

EXAMINE TECHNIQUES FOR ACHIEVING THE OBJECTIVES

Techniques employed may not always preserve or enhance the shore entirely to the extent desired, but they can contribute greatly to these ends.

• ***Engineering techniques***

Examine the application of natural processes to preserve and enhance the shore, referring to *Shore Protection Guidelines* for details on specific measures named.

When natural methods will not satisfy the physical requirements, there are some strong-arm methods, but watch for external effects named. Refer to *Shore Protection Guidelines* for details on those engineering methods you consider appropriate.

• ***Managerial techniques***

Often the solution lies in influencing land use along the shore so as to bring about the desired result: This can be accomplished through several types of motivational devices graduated in the degree to which public power is imposed over individuals.

1. Agreements such as voluntary acquisition and contract zoning.

2. Public policy inducements such as property taxes, cost sharing, land use maps, and policies for the protection of private property.

3. Regulatory controls such as zoning, subdivision regulation, building codes, ordinances, permits and orders. These devices are especially useful when employed in conjunction with an approved master plan.

4. Compulsory taking such as condemnation and inverse condemnation.

Legal aspects of each of these devices must be investigated as well as the social and economic consequences.

Industrial development generally precludes other coastal uses in the approximately one percent of the shore it occupies.

FORMULATE A SHORE PLAN

The tentative objectives that have survived the initial feasibility test implicit in the evaluation of alternative courses of action must now be integrated into a time and money schedule that considers each of the courses of action as a compatible part of the total plan as it specifies who does what, when, where and how. Funding procedures that have been used in the past are examined and their principles applied to the given situation. Institutions, agencies, managerial techniques and engineering projects are integrated into a time-phased program. Available political channels are employed to obtain appropriate assistance in promoting the program and enacting any necessary legislation.

IMPLEMENT THE PLAN

In implementing the plan, knowledge gained from unexpected developments—some favorable and some unfavorable—is channeled back through the continuing planning-implementation cycle. Comprehensive planning in shore management, as in anything else, is capable of dealing with the reality that actions taken have external impact as well as interactions among themselves in accomplishing the desired results, and that at no future date will the world become obligingly static, making further planning unnecessary. Therefore, an essential element of the program is a public relations activity that keeps interested people informed and has a way of hearing and responding to the citizenry.

BIBLIOGRAPHY

In addition to the other parts of the *National Shoreline Study* cited inside the front cover, the following selected documents are particularly applicable to the scope of *Shore Management Guidelines:*

1. City of San Diego Planning Department. *The Ocean Edge of San Diego.* San Diego, California. 1969.
2. Clawson, Marion and Jack L. Knetsch, *Economics of Outdoor Recreation.* Baltimore, Maryland: The Johns Hopkins Press, 1966.
3. Cronin, L. Eugene, Gunter, Gorden and Sewel H. Hopkins, *Effects of Engineering Activities on Coastal Ecology, Interim Report.* September 1969.
4. George Washington University. *Shoreline Recreation Resources of the United States.* CORRRC Study Report 4. Washington, D.C.: Government Printing Office, 1962.
5. Ellis, Robert, H., et. al., *The Development of a Procedure and Knowledge Requirements for Marine Resource Planning. Functional Step One, The Classification of Marine Resource Problems of Nassau and Suffolk Counties.* Hartford, Connecticut: The Travelers Research Corporation, May 1969.
6. McHarg, Ian L. *Design with Nature.* Garden City, New York: The Natural History Press, 1969.
7. North Atlantic Regional Water Resources Study Coordinating Committee, *Coastal and Estuarine Areas, Appendix U.*, New York, N. Y., 1971.
8. Odum, H. T.; B. J. Copeland and Elizabeth A. McHanan, (eds.). *Coastal Ecological Systems of the United States, A Source Book for Estuarine Planning.* Moorhead City, North Carolina: University of North Carolina, Institute of Marine Sciences, 1969. 3 vols.
9. San Francisco Bay Conservation and Development Commission, *San Francisco Bay Plan.* San Francisco, California. 1969.
10. U.S. Commission on Marine Sciences, Engineering and Resources, Panel Reports, Vol. 1: *Science and Environment* Washington, D.C.: Government Printing Office.
11. U.S. Congress. Senate. *The National Estuarine Pollution Study.* Doc. No. 91-58, 91st Cong., 2nd Sess. March 1970.
12. U.S. Department of the Army. Corps of Engineers. *Harbor and Port Development, A Problem and an Opportunity.* July 1968.
13. U.S. Department of the Army. Corps of Engineers. *Shore Protection Program.* July 1970.
14. U.S. Department of the Army. *Guidelines for Evaluating Estuary Studies, Models and Comprehensive Planning Alternatives.* August 1969.
15. U.S. Department of the Interior. Fish and Wildlife Service. *National Estuary Study.* 1970, 7 vols.
16. U.S. Office of Economic Opportunity. *Catalog of Federal Domestic Assistance.* Washington, D.C.: Government Printing Office, 1969.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 449-245

Photo Credits

Page	
6 & 7	– City of San Diego
9	– Chris Hanson, City of Miami Beach News Bureau
11 & 12	– Corps of Engineers
15	– Michigan Dept. of Natural Resources, Bureau of Water Management
17	– Texas Highway Department
18	– Texas Parks and Highway Department
19	– Larry Smith, Black Star Albert Thomasell
27	– Edwards and Kelsey Connecticut Development Commission Corps of Engineers
30	– John Crane, Black Star
32	– Michael Bry, San Francisco Bay Conservation and Development Commission
48	– N.Y. Interstate Sanitation Commission
52	– Connecticut Development Commission
53 & 57	– Kosti Ruohomaa, Black Star
55	– Heilpern